WITH SUPPLEMENT CONTAINING JUDGE COLT'S DECISION IN THE LAMP SUIT.

ILLUSTRATED ELECTRICAL REVIEW

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JAMES I. AYER.

PRESIDENT OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

JAMES I. AYER, whose term as president of the National Electric Light Association expires with the meeting at St. Louis, is a typical electrical engineer of to day. Previous to his election as president, Mr. Ayer served a term as first vice-president of the National Electric Light Association. His connection with electrical engineering interests extends over many years, and the experience he possesses has been secured in a practical school. His efficient management of the Municipal Electric Lighting and Power Company, at St. Louis, the largest arc light plant in the world, has stamped him as a man to whom the handling of great enterprises comes easily.

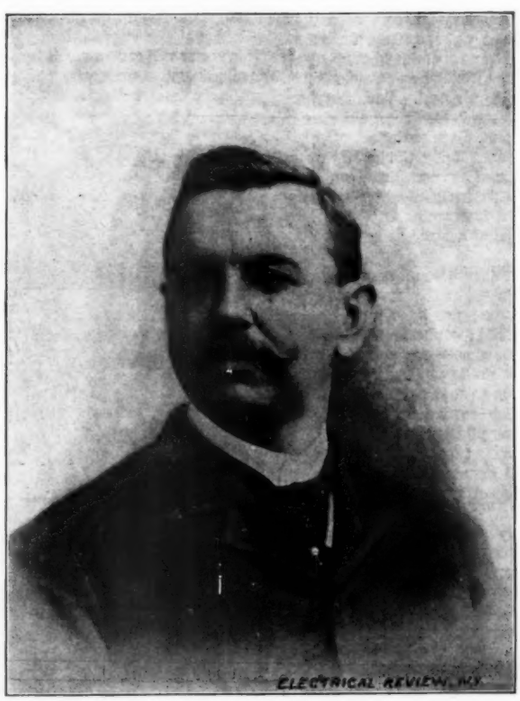
James I. Ayer was born at Medford, Mass., a suburb of Boston, on February 3, 1854. He resided in his native town until he was 13 years of age, when he moved to Elizabeth, N. J. He was graduated from the Pearl Cottage Seminary in Elizabeth in 1870, when he went west to Illinois as a civil engineer on railroad construction work. For three years Mr. Ayer followed the profession of civil engineering, and during the succeeding three years was superintendent of a mill in Illinois. From then until the latter part of 1885 he was engaged in commercial pursuits. Mr. Ayer entered the service of the Jenney Electric Company as general agent in 1885, and served in that capacity until 1889. During this time Mr. Ayer devoted much of his personal attention to the practical electrical engineering work in connection with the Jenney Electric Company's large business in the construction of central station plants throughout the country. In 1889 he was engaged to build the Municipal Electric Lighting and Power Company's plant in St. Louis, which was at that time, and is to-day, the largest arc light station in the world.

Mr. Ayer severed his connection with the Jenney Company and assumed absolute charge of the construction of this plant. On the completion of this task, which proved far from an easy one, involving many new problems in construction, Mr. Ayer accepted the general management of the company, and has since retained this important position with gratifying success.

Mr. Ayer is a deep student, having acquired much of his theoretical training through reading while traveling. He occupies a prominent position in mechanical and electrical engineering circles, being a member of the American Society of Mechanical Engineers, a member of the American Institute of Electrical Engineers, and a member of the Engineers' Club, of St. Louis. Mr. Ayer was the leading spirit in the recent organization of the Electric Club, of St. Louis, which is now in a firm position, and which will undoubtedly prove of great benefit to the electrical fraternity in St. Louis and vicinity.

Mr. Ayer is a man of strong domestic tastes. He has recently installed his charming family in an elegant house which he has built in Cabanne Place, St. Louis. Here, of course, one naturally expects to find electricity employed for every possible service, and such is the case. Alternating current is supplied to the house from Mr. Ayer's station, about five miles distant. Some 50 incandescent lamps of various candle-power furnish illumination. There is not a single gas pipe in the house or stables, and the scheme of lighting includes no electroliers. In general, the rooms in Mr. Ayer's house are illuminated by one 16 candle-power lamp placed in the middle of the ceiling and covered with a cut or tinted glass globe, while four other lamps of equal candle-power are set into the picture molding, one near each corner of the room. A magnetic switch with several sets of push buttons allows the control of the stable lights from points in the house. The wires which tap the supply circuit, which runs through an alley in the rear of the stables, are carried to the house in underground conduits, as are also the wires and speaking tubes connecting the house and stables. Twenty-eight switches control the house lights, so that illumination can always be had ahead of the master of the house if he is called up at night, and darkness can be left behind him as he proceeds through the various rooms.

Mr. Ayer's "den" is located in a sunny corner of the parlor floor, and is plentifully furnished with books, pictures and easy chairs. An electric cigar lighter is in service here. Mrs. Ayer's sewing room is fitted out with a sewing machine operated by a Meston motor, an electric flat-iron and an electric fan, besides the usual electric illumination. A complete electric burglar alarm system, electric call bells, electric fans and a telephone complete the electrical equipment of the house. It is fair to presume that in the course of time all the cooking and heating in Mr. Ayer's house will be done by electricity.



JAMES I. AYER, OF ST. LOUIS, PRESIDENT OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

The "Electrical Review" and the Year.

ITS PART IN THE PAST, PRESENT AND FUTURE OF ELECTRICITY.

With this issue, which is meant to be a Souvenir of the St. Louis meeting of the National Electric Light Association, and a brief *resumé* of the electrical development of the past year, the ELECTRICAL REVIEW begins the twelfth year of its existence.

During the last twelve months electrical history has been made very rapidly.

The incandescent lamp patents, the attitude of the General Electric Company in regard to them, and its policy toward outside lamp manufacturers, form the most prominent and interesting question of the year. This legal struggle has been surpassed only by the bitter and expensive litigation over the telephone patents. And then, just as every one had begun to think the matter settled, the Beacon Vacuum Pump and Electric Company, of Boston, brings forth the claims of Heinrich Goebel, who says he, and not Thomas A. Edison, is the inventor of the incandescent lamp. Judge Colt has thought differently, and has capped the climax by deciding the case in favor of the General Electric Company.

The topography of the electrical field has changed considerably since the issue of the Decennial Number of the ELECTRICAL REVIEW, last February.

There have been no earthquakes to crack the land and swallow up its inhabitants, but there have been landslides and washouts and severe storms to battle with. Some of the old-timers have met their fate, the weaklings have faltered and fallen, but every breach and gap has been filled and strengthened by voluntary and eager recruits anxious to join the great Army of Progress, and fight with it under the banner of ever-advancing Electricity. Nothing can check its forward march—like the ancient Grecian phalanx, its soldiers stand shoulder to shoulder, each protecting the other with his shield, and the resistless energy of those in the rear pushes ahead the whole army, even across the bodies of its own dead.

The ELECTRICAL REVIEW has been the great war correspondent of the battle; the members of its staff have been here, there and everywhere, endeavoring to gain the impartial history of every movement and present it in plain language to its readers. A small portion, a bird's eye view, of this harvest is given to you on other pages in this issue.

In the future the ELECTRICAL REVIEW will maintain the same progressive, dignified and impartial attitude which has characterized it in the past, and its chief aim will be to give its readers the electrical news as it occurs.

ELECTRIC POWER FROM NIAGARA FALLS.

Prof. George Forbes Talks Interestingly About this Important Work, of Which He is Consulting Electrical Engineer.

HYDRAULIC PLANT COMPLETED—CONTRACTS FOR ELECTRICAL INSTALLATIONS TO BE AWARDED AT ONCE—ALTERNATING CURRENTS OF 20,000 VOLTS FOR BUFFALO DISTRIBUTION — 80 PER CENT. EFFICIENCY — SUBWAYS FOR THE CONDUCTORS—GREAT DEMAND ALREADY FOR POWER—THE WONDERFUL TUNNEL — CABLES ACROSS SUSPENSION BRIDGE—GENERAL EUROPEAN ELECTRICAL WORK.

Prof. George Forbes, the celebrated English electrical engineer, connected with the initial scheme for utilizing the vast and almost limitless power which is now going to waste over the grandest falls in the world, has arrived in this country, and is expected to attend the National Electric Light Association Convention, to be held at St. Louis.

The Cataract Construction Company, of which Professor Forbes is the electrical engineer, have undertaken and have very nearly completed this gigantic performance, and have, by the employment of an enormous canal, tunnel and vertical turbines, connected with huge electrical generators, fulfilled this magnificent attempt, thoroughly consonant with American enterprise and progress. It seems almost as if these grand falls have been placed in this country for the temptation of some Americans who have now boldly plucked the fruit, and will soon offer it to the public, who will bite of it, and thus will this achievement go down to posterity.

Other companies will be formed for the utilization of the energy from other falls in the world for the distribution of power by the aid of electricity, and the poor unfortunates who fear that the continual enormous consumption of coal will exhaust the coal mines, when we shall be left without fuel, will have their fears made partially groundless by the realization of this plan.

But such grand schemes do not formulate themselves. Eminently intellectual and practical scientists must be at the head, so that a definitely determined plan may be carried out in the most perfect way. Such a man is Professor Forbes, and the Cataract Construction Company may be congratulated upon securing the services of this electrician and scientist. His world wide reputation and most intimate knowledge of what has been accomplished and what will be done at and about Niagara, will most assuredly prove of interest to the many readers of the ELECTRICAL REVIEW.

Hearing that Professor Forbes had secured accommodations at the Holland House, immediately after his arrival in this city last week, a representative of the ELECTRICAL REVIEW called upon him to obtain his views on the Niagara power station, and incidentally to learn of his recent doings in England.

On being shown to his room, Professor Forbes greeted the REVIEWITE in his usual hearty manner, and inquired what he could do for him.

"Professor Forbes, the public takes a great interest in your connection with the Niagara Company, and I feel sure that whatever you may wish to tell the REVIEW of the particulars of construction will be highly appreciated by its readers."

"Well," he answered, "you see, we have entirely completed the hydraulic part of our plant, and we are at the present time ready to continue on the installation of the electrical portion."

"Have you opened any bids as yet?"

"Yes, bids have been opened, and I think I may say that by next week the awards will be made. We have had bids from many companies, but we have not yet fully decided on all particulars."

"What kind of generators will you use?"

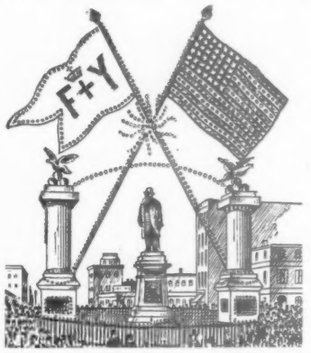
"Well, for Buffalo distribution we shall undoubtedly use the alternating current system, but as regards the local plants, we have not made up our minds whether the current shall be continuous or alternating. Of course, you understand that there may be many arguments advanced in favor of both, and you may rest assured that the one which has the most commercial advantages will be adopted beyond any doubt. From the central station we shall send out a current of about 20,000 volts, and for the Buffalo line we shall have a step-up transformer for the line and a step-down transformer for distribution, which distributing current will be somewhere in the neighborhood of from 1,000 to 2,000 volts."

"Could you let me have the full particulars and figures?"

"During my voyage I calculated all these data and have obtained exact figures, which will appear later."

"What losses are due to transformation?"

"These, of course, I have also calculated, and in the transmission of power to Buffalo, when the current is delivered to



ELECTRIC DECORATIONS AT COLUMBUS CELEBRATION, ST. LOUIS. TWO FLAGS MADE OF COLORED INCANDESCENT LAMPS.

motors on the line, we expect to have 80 per cent. efficiency after one transformation. In the second transformation to other plants along the line we expect to obtain an efficiency of 76½ per cent. You, therefore, see that the losses in the line would come to about 3½ per cent. These are indeed very close figures, and, considering the initial cost for the production of current, there can be no doubt that this mode of distribution of energy will be most profitable."

"What kind of motors do you expect to have used?"

"That is rather a hard question to answer, for those which the company advises will no doubt be generally adopted."

"I see," said I; "plans not having been completed, we cannot expect to obtain this information; but do you expect alternating current motors to be the kind used?"

"Alternating current dynamos may be used, or a rotary field motor like Tesla's, or motors run with two currents differing in phase by 90 degrees may be employed. These motors, of course, will have to be started gradually. There are people in Europe who have been getting out commutator apparatus for changing alternating current to continuous current, and now there are over a dozen kinds of motors operated on single phase currents in the market; there are not many of these in use, but they are practical. There seems to be some mistake about the efficiency of alternating current motors, but actual installation will show these people that they are wrong. There are firms now who manufacture different kinds of alternating current rotary field motors who will guarantee 92 per cent. efficiency."

"What do you expect to use in the line equipment?"

"Subway conduits, most assuredly. They are handier for inspection, and less liable to get out of order from numerous causes, among which may be mentioned storms, etc., which will make the maintenance of an overhead system exceedingly expensive and troublesome."

"Have any rates been arranged yet for the consumption of current?"

"Rates have been formulated and they will be made known when the plant is in operation. The consumption of power will be enormous. Large demands in Buffalo have made us anticipate the utilization of all the power that we can possibly obtain. The turbines which we are constructing are capable of generating 5,000 horse-power each. They have a vertical shaft 240 feet in length, to which will be attached directly either the armature or field magnets of the generators."

"Is not the introduction of armatures mounted on a vertical axis an innovation?"

"No, I believe that there are several which have been constructed. The generators which we will use will have about 250 revolutions per minute, and whether the armature or the field magnet shall revolve has not been decided."

"Do you expect to use your tunnel entirely for the production of power for your own generators?"

"No, we shall rent turbines to other companies. We expect to have about 20 turbines of our own, which will give us an aggregate power of 100,000 horse-power. The Niagara Falls Paper Company owns a turbine and has rented the right to use the tunnel."

"You say that all the hydraulic plant is completed?"

"Yes, the tunnel is finished, the canal has been built, and we have finished three wheel pits, with which we will start operations. In the neighborhood of the plant is a company which expects to refine copper by electricity on a very large scale."

"I suppose there will be no trouble at all in selling the power?"

"No; we have had numerous applications to lease power, and as much as we can generate will be gladly sought for by all those who have occasion to use it. These numerous applications are very flattering, and at the present moment there is a company in Buffalo which is making contracts throughout the city for power, and the distribution of the current through the city. This power will cost so much less than that obtained from steam engine plants that this will be an extra inducement to consumers.

ELECTRIC LIGHTED GLOBE, COLUMBUS CELEBRATION, ST. LOUIS.

The running expenses are a mere nothing. The amount of attention will be small, and the work has been so carefully supervised that it will be almost impossible for any accidents to occur."

"This tunnel must be quite a wonderful piece of work, and will no doubt be as lasting as the Pyramids?"

"Yes, it is a very large and well constructed piece of work. Its total length is 6,700 feet. The canal which feeds it is 500 feet wide and 1,500 feet long. The inclination of the tunnel is seven feet in a thousand, just enough to obtain a good course of water, the velocity of which is 25 feet a second. This stream issues from under the Suspension Bridge."

"By whom were these turbines designed?"

"They were designed by Messrs. Faesch & Picard, of Geneva, and they were constructed by the I. P. Morris Company, of Philadelphia."

"It seems to me, Professor, that with this power so much in demand you will not be satisfied to stop when this one plant is completed, but you will extend your installation and try to generate as much power as will undoubtedly be required?"

"Yes, we have the right of way under the city for a parallel fall for another 100,000 horse-power, and we have obtained a concession for the Canadian side of the Falls for another tunnel. Professor Unwin is now preparing plans, and with this tunnel we shall probably obtain an additional 250,000 horse-power."

"From which side of the Falls will you distribute your current?"

"We have not decided as yet, but if it is distributed from the Canadian side, cables will be run over the Suspension Bridge."

"What size cables do you expect to use for the transmission of power?"

"We expect to use one cable for each 5,000 horse-power, both wires of which will have an aggregate cross section of one square inch. These are all the points that I can give you now concerning the construction of this huge plant."

NEW ELECTRIC INSTALLATIONS.

"Have you recently inspected any plants in Europe?"

"Yes, I have lately examined one which is situated at Tivoli, and the line extends between this place and Rome, and carries about 5,000 volts. I have also inspected a continuous high tension current station at Geneva."

THE FRANKFORT TRIAL.

"What, in your opinion, was the effect of the recent trial of the transmission of power at a distance at Frankfort?"

"I can say that this has decidedly given an impetus to the many schemes for the transmission of power at a distance, and the falls at Lauffen now furnish power for the neighboring city of Heilbron. This current is distributed on the three-phase alternating current system."

THERMAL STORAGE AT THE ELECTRIC LIGHT CONVENTION.

"Do you expect to take part in the National Electric Light Convention?"

"I am not quite sure whether I will discuss any paper, but it may be possible that I shall read a paper on thermal storage. I have all the data and I might bring it before the association."

REFUSE TO BE UTILIZED FOR GENERATING STEAM.

"Are you interested in any other schemes for the generation of electricity?"

"Yes, the enormous amount of refuse daily produced in the numerous cities in England has made me think of different means for its destruction and utilizaton for generating steam. This enormous quantity of apparently useless matter has been burned, but the heat obtained by it has not been utilized to any extent. I hope, however, to use this as fuel for electric lighting plants. I have all the data concerning the amount of refuse, the temperature obtained from the burning of it, and I can safely say that in any town in England there is sufficient refuse produced to furnish each inhabitant with power enough to light a 16 candle-power incandescent lamp for two hours every day of the year."

THE LIVERPOOL ELECTRIC ROAD.

"Have you taken any interest in electric traction?"

"Well, just when I left Liverpool they had opened the elevated railroads, which I must say are an enormous improvement on the South London underground railroad. The success of this undertaking has given great confidence to six or seven companies who have already applied to Parliament for franchises."

AN INVESTIGATING TOUR.

"Do you expect to be busy while you are here in examining central stations, power houses, etc.?"

"Yes, in five minutes I have to take a carriage for my train, and I am now going on a tour of inspection in the many adjoining cities, and I expect to have every moment of my time employed. I am sorry that I cannot give the REVIEW as much information as I would like, had I the time, but in this country trains don't wait for people. I am sorry, but I must tell you good-bye."

Thanking the Professor for his kindness in granting the interview, the REVIEWITE passed down the magnificently furnished corridors of the Holland House replete with electrical conveniences of every kind. As I left, the Professor was seen to grasp his coat and grip in true English style and start on one of the many trips that he is to take while on this visit to our country of progress and invention. J. A. M.

THE INVENTOR.

BY JULIAN A. MOSES.

The Almighty, in His far-seeing wisdom, has thought fit to bestow upon His human subjects the possession of many characteristics which, from personal contact and familiarity with them, we choose to call senses, habits, instincts, etc.

With some He has been, as it seems to us, more lavish in His bestowal of much coveted gifts, and to these we mortals give the names geniuses, wonders and phenomena.

That which appeals to our senses, and which is readily appreciable by the ordinary mortal, is not superficially considered wonderful; but it is only the unfamiliar and exaggerated, and that which is not immediately the next step in the direct line of progress, which attracts our special attention and brings forth from us expressions of astonishment, respect and admiration.

The so called Divine gifts are few, indeed, and he that possesses any one in a marked degree is termed a genius. Geniuses are naturally rare. More moderate species exist, and they are, by courtesy, given the same name as the original.

To this latter class belong poets, musicians and inventors. It may seem strange to class the inventors with poets, but they are all more or less inventors; the poet invents beautiful thoughts and clothes them in a garment of his personality, and the musician does the same thing with harmonies; but the inventor combines the new with the useful and thus materially and progressively benefits the condition of all mankind.

The inventor's name is legion. Upwards of nearly half a million patents in the United States patent office alone can testify to the number of "new and useful improvements, etc.," the inventors of which have had enough assurance of their success to warrant the initial investment required by law for governmental protection.

Despite the many statements to the contrary, the life of an inventor is a happy one. Variety being the spice of life, his is, indeed, well seasoned. Always on the lookout for something new, his energies are bent towards solving some unsolved problem, and the mainstay of his existence, if he be a true inventor, is hope. His motto is "Excelsior" and his watchword is "Progress."

There is a question whether the inventor is born or made; whether he comes into the world a germ of future greatness or whether force of circumstances and surrounding and unexpected conditions lead him to seize this means of benefiting the present and coming generations.

The born inventor is rare, but the made inventor and his characteristics are worthy of study as a particular class of the many enthusiasts who are ever ready to build castles in the air and to rise phœnix-like from the ashes of their burnt-out fires of expectancy.

It will, perhaps, be interesting to hear of the emotions of a certain made inventor who was not well off in worldly possessions. They may be related as follows:

He recognizes that necessity is truly the mother of invention, and seeing an unfilled necessity, undertakes, in the fervor of the *divinus afflatus*, to fill the void and to realize his instantaneously conceived visions of brilliant success.

He thinks, and then considers hastily what is the next thing to be done. With a species of mild egotism, he feverishly puts his immature ideas into a visible form and sees the first real intimation of his capabilities. Immediately his ideas expand; one thought leads to another; a chain is formed, but, unfortunately, many a time is there a weak link which will part under the merest strain of practical application.

Now comes an unfortunate period of his existence; secrecy at first is predominant, but the universal feeling of companionship crops out, and he must share his ideas with some kindred spirit.

The slightest evidence given by the sharer of this first joy in favor of its patentability and value is magnified in his eyes. This ready appreciation "makes all the world akin," and his path becomes illuminated with a light of rosy hue. This is dangerous, for if his idea is valuable, its worth may be appreciated by a cold reasoning person, and the inventor forgets that he should "treat a friend as if he might some day become an enemy."

Many inventions have been torn from their owners in this way, and scores of inventors live to tell stories of heartaches, privations and disappointments.

Finally, he resolves upon a desperate course. He must procure a patent. Night after night he lies awake, dreaming of the proper wording, so as to avoid complicated lawsuits, which, he thinks, are bound to arise when this child of his brain has grown to gigantic proportions, and when he asserts his right of parentage.

He has seen, but he has never experienced. Woe to him when he does, for nothing makes some people so envious as success.

He has his patent and he seems like a child with some new toy. Soon the feeling of novelty wears off. His old ideas about the immense value of his treasure again loom up on the horizon, and they cast a golden light on his course. Plan after plan is revolved in his mind, and the cry becomes "To the capitalist."

Patent in hand, with joyous step, he ascends to the magnificently furnished room of the man of money before whom he feels awed but confident. His expectancy grows. The words are spoken.

A blank expression settles itself on his features, and a mere tyro in physiognomy can tell that this is his first experience.

Now he descends the steps, but with a different tread. The world apparently dislikes him.

He imagines that people can see his innermost thoughts, and every little incident that happens he seems to feel is directed against his will. Gloomy visions come and a restless night awaits him.

But his motto is "Excelsior," and he cheers up under the influence of the magic word.

Onward! Courage! Conflicting emotions of despair and hope nearly neutralize each other. Hope predominates; but the contact with the rough side of the world has rubbed off much of the glamour that surrounded this first conception, and the effect of this disappointment is bitter. His enthusiasm has cooled.

Time has elapsed, numerous repetitions of these experiences have altered him; his disposition is hardly recognizable, but he has still left the magic word "Hope." It lives with him, and the constant companionship has made it permeate his whole being.

Circumstances, too, have conspired against him, and his home is changed.

* * * * * * * *

The scene dissolves, and years pass.

I am called hastily to a wretched tenement house and see my old acquaintance, the inventor. Time has laid his hand heavily on him and he lies in a dilapidated bed in a miserably furnished room. As he sees me, his eyes light up with a look of recognition.

I am not a bit too soon.

He smiles and nods in a seemingly childish manner, and points with his bony hand to several drawings which are lying on a pine table, illuminated by the light from an old kerosene lamp, feebly muttering:

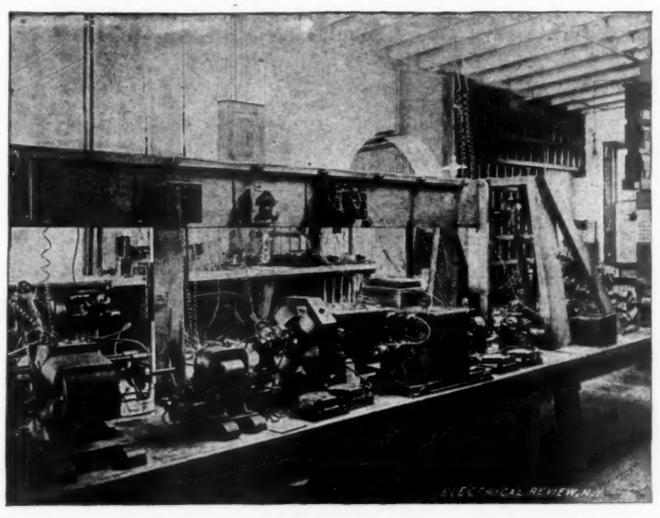
"There, there; not this time! Well, courage, old man! You are not at the end of your rope yet, you—" The last words die on his lips and his glassy eyes look toward the ceiling, with a vacant stare. The Angel of Hope had smoothed out every line of despair from his wan and pallid face.

Gently I cover his face with the meagre bed clothing.

His expectations were at last realized.

As I stoop to arrange his hands across his heart, I quietly take from his stiffening fingers, a roll of paper, on the front page of which can be seen a large red wafer, stamped with the seal of the United States government.

JUDGE L. B. B. COLT, OF THE UNITED STATES CIRCUIT COURT, WHO DECIDED IN FAVOR OF EDISON AND AGAINST GOEBEL.



VIEW IN THE LABORATORY OF THE AMERICAN TELEPHONE & TELEGRAPH COMPANY, NEW YORK.

JUDGE L. B. B. COLT.

THE UNITED STATES CIRCUIT JUDGE WHO RENDERED THE DECISION IN THE EDISON-BEACON LAMP CASE.

Judge L. B. B. Colt, whose portrait we take pleasure in presenting to our readers, and who rendered the decision in the recent Edison-Beacon lamp case, which has attracted such widespread interest in electrical circles, is one of the most prominent figures in the United States Circuit Court to day. He comes of good old New England stock, his father being Christopher Colt, brother of Samuel Colt, of revolver fame, and his mother a daughter of General Geo. DeWolf, of Bristol, R. I. He was born in Dedham, Mass., June 25, 1816, and is now in his 47th year. After a preparatory course at Williston Seminary, he entered Yale College in 1861 and graduated in 1868. From here he entered the Columbia College Law School, and after his graduation, in 1870, spent a year in traveling in Europe.

On his return home he settled in Chicago where he practiced law until 1876, when he came East and located in Rhode Island, having his office in Providence and his home in Bristol, where it still is. From 1876 to 1881 he was in partnership with the Hon. Francis Colwell, now city solicitor of Providence. During this time, from 1879 to 1881, he was a member of the Rhode Island legislature, and was appointed United States District Judge for Rhode Island by President Garfield in March of the latter year. In July, 1884, he received the appointment of United States Circuit Judge for the First Circuit from President Arthur, which appointment he now holds. His brother, Samuel P. Colt, of Bristol, R. I., is president of the Industrial Trust Company, of Providence, and also president of the National India Rubber Company, of Bristol, R. I.

Judge Colt is a man of fine presence, strict integrity and unbiased judgment, and is universally loved and respected, not only by his associates on the bench, but by all with whom he comes in contact. That he is well known and esteemed among the electrical fraternity is made evident by the universal expression of opinion, on learning that the recent case was to come before him, that "No better man could have been selected."

LITERARY.

"How to Manage the Dynamo," by S. R. Bottone. Sixty-three pages, cloth, illustrated. Price, 60 cents. This book, by the author of "The Dynamo, How Made and Used," and several other well-known and valuable books, is intended for the use of persons who may wish to undertake the management of an electric lighting plant. The dynamo, its defects and remedies, are dwelt upon in a practical way. A table of definitions of mechanical terms is subjoined, and will be found at the end of the volume. This book will be supplied by the ELECTRICAL REVIEW Publishing Company, 13 Park Row, New York.

"Tariffs of Foreign Countries," one of the Special Consular Reports issued from the Bureau of Statistics, Department of State, has reached us. This volume, composed of letters in answer to a circular from the Department of State, is replete with particulars of tariff rates on almost every conceivable commodity from all the countries of the globe. Any information, coming as this does, from such reliable sources, cannot fail to be of interest to those who may at any time desire enlightenment on questions relating to the *minutiæ* of tariff rates. All requests for these reports should be addressed to the Secretary of State.

The February number of the *Magazine of American History*, the first presented by the new publishers since the consolidation with the *National Magazine*, contains so many extremely interesting and important papers as to make it the most admirable issue of an American historical magazine we have ever seen. The Lincoln letter, of which a *fac simile* is given, is here presented for the first time. It was written at General Grant's headquarters and was transmitted to Mrs. Lincoln over the wires in cipher. The account of moneys furnished by Lewis Pintard, the American commissary of prisoners, is a most interesting revolutionary document.

The Largest Arc Light Plant in the World.

THE MUNICIPAL ELECTRIC LIGHTING AND POWER COMPANY, OF ST. LOUIS—HISTORICAL SKETCH OF THE COMPANY AND ITS STATION—METHODS AND MEANS OF OPERATION.

The Municipal Electric Lighting and Power Company, of St. Louis, succeeded to the city lighting contracts and franchises awarded to Chas. Sutter, on March 9, 1889, and at once entered upon the construction of what was then and what is now the largest arc light plant in the world. In February of that year Mr. James I. Ayer was summoned by telegram from the general manager of the Jenney Electric Company, of Indianapolis, Ind., to come to St. Louis

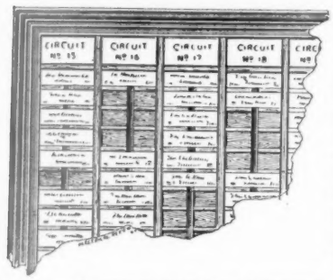


FIG. 1.—MUNICIPAL ELECTRIC LIGHTING AND POWER COMPANY'S RACK SYSTEM OF RECORDING COMMERCIAL LIGHTS.

and render such assistance as he might to Mr. Sutter, who had at that time filed his bid with the city for lighting. Mr. Ayer was then general agent and expert for the Indianapolis company. During the exciting contest between the representatives of the rival bidders, each claiming the superior merits of his peculiar products, Mr. Ayer remained in St. Louis and participated in the scramble. Mr. Sutter, at the time of the awarding of the contract, was president of a local company, organized to promote the interests of a storage battery, and had with him a man on whom he depended to carry out the contract and the construction of the plant. Soon after the contract was awarded, Mr. Ayer went to Sedalia, where he sold a large plant to that city; thence to Marietta, Ohio, and then to Sharpsburg, Pa., when he was again called to St. Louis, and arrangements were completed whereby he took full charge of the work of completing and putting into operation the plant. This was on the 20th of May, 1889, when much valuable time had been lost and absolutely nothing had been done in the way of a plant of any sort. To say that this plant was put in operation on the first of the succeeding May, 11 months and 10 days from the date of first entering upon his duties of laying the plans and executing the work, indicates that he did not have much idle time. There is a peculiar fact connected with the starting of the plant of which Mr. Ayer is really proud, and that is, notwithstanding its magnitude and the ramification of its details, the plant started on time, lighting the city on the first day of May, the day agreed upon some months before by Mr. Ayer, and the work of operating the plant has gone on without interruption from that day. The first few days of operation of new plants of much smaller size are usually a series of starts and stops, but with this plant this experience did not obtain. Every man knew his duty and performed it, and Mr. Ayer knew from absolute personal knowledge that every detail of the machinery was in proper working order to perform its part of the necessary work. The arrangement and mechanism of the station, and the distribution of current, covering an enormous area of territory, had in every particular been inspected and tested out under his personal supervision. The capital stock of the Municipal Electric Lighting and Power Company is $1,500,000, with a bonded debt of an equal amount. The president is Mr. R. T. McDonald, who is also general manager of the Ft. Wayne Electric Company, of Ft. Wayne, Ind.; James Campbell is vice-president; John G. Kelly, secretary and treasurer; and James I. Ayer is the general manager.

The boiler plant is of peculiar construction. The design of the boiler is novel, and was made by local contractors, Messrs. Rohan Bros. The contract for the boilers was the only one over the awarding of which Mr. Ayer had no control, as it was made prior to his engagement with the company. These boilers, being a new type, and different from what has ever been constructed before, and hastily built (although of first-class material and excellent workmanship), have not given the satisfaction that might have resulted had the proper time for experimenting with and trials of the boilers been taken, so as to determine what were their objectionable features and weak points. The designer of the boilers was actively engaged in business, and did not have the time or opportunity to follow out details, and, as a result, the boilers have not been as satisfactory as they would have been had the conditions been different. The boilers are of the porcupine type, with tubular vertical sections on top and also at the bottom of the porcupine section, and have the locomotive construction of fire box. They are upright in form, 35 feet high, and there are 19 of them, each of a rated capacity of 300 horse-power. The boiler house is a three story brick building, 60x110 feet.

The steam piping from the boilers is as follows: One 24 inch main, running from the receiver in the boiler house, through a tunnel the entire length of the engine room, to which all engines are connected. This pipe is made with cast iron expansion joints, hot riveted. A similar pipe of 18 inches diameter, as an auxiliary supply pipe for use in emergencies, runs in a similar manner from the receiver and connects with the

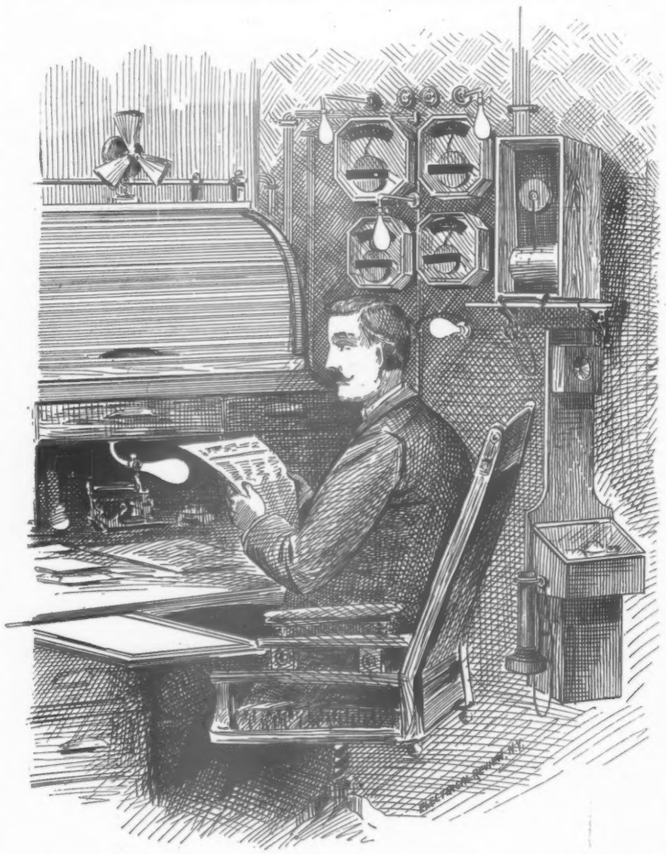


FIG. 2.—MUNICIPAL ELECTRIC LIGHTING COMPANY.—VIEW IN GENERAL MANAGER AYER'S OFFICE, SHOWING CURRENT INDICATORS.

engines. A 10 inch pipe connects four boilers independently with two engines. These two engines can be run from either the large or small pipes. For daylight work the small pipe only is used, and at a very material saving. Underneath all live steam pipes in this tunnel lies an exhaust pipe, 36 inches in diameter, with a grease extractor placed in it a short distance from last engine, which takes out all greasy water at that point, leaving all water which condenses beyond that point to return to the hot well and be pumped again into the boilers, thus effecting a saving of from 35 to 40 per cent. of water. The exhaust steam goes to six pressure exhaust close coil heaters, thence up into a header from each heater, through the roof to a header on the upper portion, and from there into the air. This arrangement gives a very large condensing surface. All the boilers are connected to an iron stack, 13 feet in diameter at the bottom and 205 feet high from the base of the building, made of boiler iron. This stack was put up in sections, and all of the work of hoisting the material was done with a one horse-power electric motor.

In the station are six Hamilton-Corliss engines 25x60 inches and one 30x60, six of them rated at 600 horse-power each and the other at 720 horse-power. Each engine is belted to 52 feet of six-inch shafting located on the floor above, supported on floor stands, and on which are placed double-crown friction clutch pulleys, which drive the arc dynamos on the floor above, as well as the alternating current dynamos on the floor below. The shafting and clutch pulley work was furnished by the Falls Rivet & Machine Company, Cuyahoga Falls, Ohio, and has proven very satisfactory and efficient.

On the third floor are seventy-eight 2,000 candle-power Wood arc dynamos, 12 of which are 80 lighters and the balance 60 lighters. These dynamos are stopped and started by the use of levers connected with the friction clutches on the floor below, independently of each other. The arrangement is such that one boy conveniently cares for from 12 to 15 arc machines while running. In starting, the clutches are thrown out, the engines get up speed, the clutches are thrown in and the dynamos started in pairs. For city lighting, when the hour arrives, the entire load is usually thrown on in one minute or less, and with no extra attendance other than that required for the care of the dynamos as mentioned above, viz., one to about every 12 or 15 machines.

There are five 3,000 light Slattery alternating current dynamos located on the engine floor, distributed over four engines. This arrangement enables the alternators to be run in conjunction with the arc machines, so that the load can be nicely balanced at any period of the 24 hours. The wires leading from the dynamos, as well as belts, are contained in the shafting floor below, so that the dynamo room is left entirely free from unsightly wires, and the horizontal belts very much facilitate the work of caring for the dynamos, as well as affording easy access and observation to employés and those in charge.

The arc switchboard is divided into eight sections, about six feet square, within which are placed terminals of all circuits. The dynamo terminals are placed in a continuous row along a table on the base of the board. By this arrangement, the operator, with a cable not exceeding eight feet long, can attach any circuit to any dynamo. Each circuit has an indicator at the top of the board, the needle of which indicates whether the circuit is alive or not, and the direction of faults or grounds. On the table where the dynamo terminals are placed are located sockets for the introduction of ammeter plugs, thus enabling the operator to determine the ampere current flowing in any circuit, by the use of a suitable plug and cable which is attached to a standard ammeter. This is a feature which is of value, because it guarantees the same ampere current on all circuits at all times, which is not true when the circuits are governed by independent ammeters, which it is not possible to keep in correct adjustment.

The wire tower is placed on the roof of the building, the front of which is made of hollow tile, through which glass tubes are run for leading in the wires. A suitable rack carrying cross-arms is placed in front of the tower, and the wires are run from this through the glass tubes in front of the tower, through similar tubes held in cross-arms on the interior, down to a rack, on which are placed lightning arresters, and to the testing board. The arrangement of the entrance of wires into the building is such that additional wires can be added indefinitely to the capacity of the tower without, in any manner, disarranging the wires previously brought in. The dynamo and engine house is a four story brick building, 100x110 feet.

The wires lead from the station on two lines of poles up to a cross street, where they are carried on three lines of poles to cross streets and distributed over a series of trunk lines throughout the city, covering an area, in St. Louis and East St. Louis, of about 66 square miles. The alternating distribution covers an area of about 30 square miles. There are in service 2,100 arc lamps for street lighting and upwards of 1,400 for commercial lighting. All incandescent lamps are in commercial use, of which there are something over 22,000 connected up.

In addition to the power plant at this station, the station formerly used for supplying incandescent lights on the Heisler system has three 500 horse-power generators for power, of the Fort Wayne and Thomson-Houston pattern, having about 250 kilowatts capacity. There are also one 3,000 and one 1,000 light Slattery alternating dynamos. These latter machines are connected by suitable mains to the switchboard at the main station, and connected to various feeders from there when in use.

There are 30 trimmers, with carts, to care for the city street lights. These trimmers have an average of about 75 lamps each, and the distance driven by each trimmer daily is about 20 miles. There are also 15 commercial trimmers who care for the 1,400 commercial lamps, having an average of about 90 lamps each.

There are three inspectors and trouble men, supplied with carts, for daily repairs to lamps and lines and inspection of circuits, and four on duty at night. One of these is kept at the general headquarters in the down-town district of the city, who attends fire calls and is assisted by two inspectors without carts in the care of commercial lights, attending to fire calls and other faults. The other three are kept on duty at the station, subject to call throughout the night for any and all purposes. In addition to this, there is one meter inspector, supplied with a buggy, and one man whose duty it is to place meters and lamps after all other connections have been made by the linemen, whose whole time is occupied with this work.

A little over a year ago the company had no alternating system, and within a period of about 14 months they have put up their lines and secured the business above mentioned; viz., connections for over 22,000 lamps.

A circuit record is kept in the office and at the plant. A rack, similar to a room rack used in a hotel, is kept in the office, and under the numbers of each circuit are the names and locations of lamps, each customer having a separate slip, and as changes in

the circuit are made these slips are added or removed, giving at a glance the condition of the circuit and the number of lamps thereon.

For the proper checking of the station, voltmeters are attached to pressure wires run from centers of distribution of the different alternating circuits, and placed in the general manager's office, so that at a glance the pressure on any circuit is known. The office is kept open day and night, and a telephone clerk is in charge, whose duty it is to receive all messages relative to the business of the company. These he enters on a suitable blank, from which a ticket is made, which is given to the inspector, who calls on the customer, attends to his complaint, and from him takes a receipt. These receipts are checked against the complaint

Newel Light on Grand Stairway, Southern Hotel, St. Louis.

sheet, so as to insure their having had attention. It is the duty of the clerks in charge, also, to keep track of the pressures as shown throughout the night on the various voltmeters, and to caution the station if any neglect is indicated by high or low pressure on the circuits. As an additional check, a recording voltmeter is kept in circuit, which automatically records the pressure throughout the twenty-four hours. This is a check, both on the station and the clerks in charge at the office.

The workshop and storeroom are located on the upper floor of the main station. Here all repairs to lamps and machinery are made, lamps and meters tested and adjusted and turned over to the storekeeper, who issues and charges out everything that leaves the storeroom.

The system of issuing supplies to the crews and linemen is worthy of noting. The line superintendent receives his orders for such connections as have to be made. He looks up the locations, notes the material required, and makes out an order on the storekeeper for the material required for each job, and indicates the foreman who will be required to do the work. In the afternoon each foreman's supplies are gotten out and grouped together, with his name on them, and in the morning he receives his working orders, which are on blanks furnished to the line superintendent from the office, and the supplies are immediately laid onto his wagon; thus avoiding the inconvenience and delays incident to dividing a large amount of work among the various crews each day. There are regularly employed six crews of linemen, of from five to 12 men each, according to the character of work they are expected to do.

The Municipal Company has its own pole wagons and trucks and a full complement of horses, which are housed in very comfortable stables. Adjoining the stables is a blacksmith shop where all repairing and horseshoeing is done.

St. Louis, the Metropolis of the Mississippi Valley.

FACTS AND FIGURES ABOUT THE CITY—PUBLIC SPIRIT A PROMINENT CHARACTERISTIC—AN ELECTRICAL CITY OF MAGNITUDE.

St. Louis is the chief city of Missouri, one of the wealthiest cities of the Union and the commercial metropolis of the central Mississippi valley. It is the largest city on the largest river in the world, being located on the right bank of the Mississippi River, about 20 miles below the entrance of the Missouri. In 1870, St. Louis had 310,864 inhabitants, and ranked as the fourth city in the United States in population. The present number of inhabitants is about 455,000, and St. Louis ranks fifth in the list of large cities of the United States.

The city is amply provided with parks and boulevards and contains many fine residence districts. The public school system in St. Louis is regarded as among the best in the United States. The rapid transit facilities of St. Louis are remarkably good, electric railways being numerous and efficient. There are about 225 miles of street railway track within the city, and about 90,000,000 passengers per year are carried. There are about 2,300 city arc lights on 430 miles of streets, and 1,700 incandescent lights on 90 miles of streets, while there are about 100 incandescent lights in 60 acres of parks. There are a number of electrical manufacturing companies located in St. Louis, and the business done during 1892 amounted to about $6,000,000. St. Louis is an electrical city of magnitude, the use of electricity in residences being especially marked.

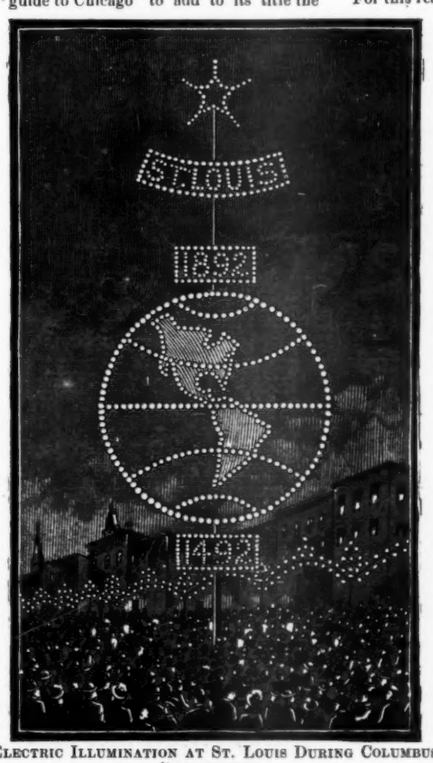
As a distributing center St. Louis has no superior, commercially speaking. The city is central to a greater productive area than any other city in the country. The conditions are tending every year to make St. Louis the "hub" of the railway systems of this country. A new Union Depot is now in process of construction in St. Louis which will have the largest train shed in the world, with a capacity for 32 full trains. The structure will cost $1,500,000, the depot alone being estimated at $500,000 and the land involved in the matter having cost in the neighborhood of $4,500,000. When completed it will be one of the most commodious passenger railway stations in the world. There are two great railway bridges across the Mississippi connecting St. Louis with the Illinois shores. One is the famous Eads bridge and the other is the recently completed St. Louis Merchants' bridge. The river traffic at St. Louis forms an important item in the commercial life of the city, the value of the river equipment being in the neighborhood of $12,000,000.

One of the most marked characteristics of St. Louis is the public spirit of the citizens. The growth of this city has come about in a quiet way, but with steady progress, which is largely due, undoubtedly, to the sensible methods of advertising the place adopted by the citizens of St. Louis who have the matter in charge. An organization known as the Autumnal Festivities Association has succeeded in raising a subscription fund of $1,000,000 from St. Louis merchants and business men, for the sole purpose of advertising the city and making it attractive to visitors. The annual carnival of the Veiled Prophet is well known and forms one of the most attractive features of the year in St. Louis. Beginning in September of each year, the city is given over to 40 days of carnival and illumination. During this time the permanent exposition at St. Louis is open to the public. This exposition is, by the way, the most successful one of its kind in the world, and is probably the only one which completes each year financially sound. Many thousands of visitors come every year to St. Louis to witness the illuminations which are of an extremely attractive and inviting character. Both gas and electricity are employed for this purpose, but the old method of illumination is gradually being replaced by the newer one. Last year the designs composed of electric lamps were extremely beautiful and unique, and it is probable that during this, the World's Fair year, St. Louis will surpass herself in this direction.

The Autumnal Festivities Association has done a wonderful amount of good for St. Louis, one of its greatest achievements being the completion of arrangements for the building of a new $1,000,000 hotel. St. Louis will offer many attractions to the visitors to the World's Fair at Chicago, this year, and he who goes to Chicago and fails to include St. Louis in his itinerary will make a great mistake.

In a recent article in *Harper's Magazine*, written by Julian Ralph, and entitled "The Growth of St. Louis," the author refers to the Autumnal Festivities Association, as follows:

It may cause a smile to read that Chairman King and Secretary Cox report, in a circular now before me, what work the bureau of information has done "to correct any false impressions which have been created by the too great modesty of St. Louisans in the past." But they are right, for, as compared with its rivals, St. Louis possessed that defect, and the frank admission of such a hated fault shows how far removed and reformed from retarding bashfulness that city has since become. The bureau reports that it is causing the publication of half-page advertisements of St. Louis, precisely as if it were a business or a patent medicine, in 62 papers, circulating more than a million copies; that it has obtained reading notices in all those dailies; that "articles on St. Louis as a manufacturing and commercial metropolis and as a carnival city" are sent out every day; that arrangements are making for a weekly mail letter to 500 southern and western journals; and that once or twice a week news items are sent to the principal dailies of the whole country. It was found that St. Louis was not fairly treated in the weekly trade reports published generally throughout the country, and this source of complaint has been removed. Invading the camp of the arch-enemy—Chicago—the bureau has caused a handsome "guide to Chicago" to add to its title the



Electric Illumination at St. Louis During Columbus Celebration.

words "and St. Louis, the carnival city of America." It is also getting up a rich and notable book, to be called "St. Louis Through a Camera," for circulation among all English-speaking peoples. The local service for the press telegraphic agencies has been greatly improved, "and the efforts of the bureau to increase the number and extent of the notices of St. Louis in the daily papers throughout the United States have continued to prove successful," so that "instead of St. Louis being ignored or referred to in a very casual manner, it is now recognized as fully as any other large city in America."

The delegates of the National Electric Light Association will find much to instruct and amuse them in this Western metropolis, and those who have not heretofore been familiar with this city will doubless feel well repaid for their visit to St. Louis.

The Possibilities of Railway Speed.

BY GEORGE WESTINGHOUSE, IN THE NEW YORK "COMMERCIAL ADVERTISER."

There is no question about the development of a much higher rate of speed than that which even the fastest service on the railroads of to-day maintain. I presume that a speed of from 90 to 100 miles an hour could be secured with modern locomotives and with the improvements which are sure to come.

But I am inclined to think that other influences may operate to prevent in the next century the running of railway trains at such a speed as I have seen mentioned in some of the newspapers. It is not a question of attaining speed, but a question of the control of the train after great speed has been secured. Suppose, for instance, that a railway train is going at the rate of 90 miles an hour. The engineer sees a danger signal or an obstruction on the track 1,000 feet away.

Now, experiments have shown that with a perfect brake, acting under the most perfect conditions, it is impossible to procure a greater retarding effect than would be equivalent to stopping a train going at the rate of three miles an hour in a second of time. It is, therefore, easy to make a computation of the effect of such a brake upon a train running 90 miles an hour within 1,000 feet. When the engineer had reached the danger signal or the obstruction, his train would still be going at the rate of 60 miles an hour, and if he was running his engine at the rate of 60 miles he could only check it to a rate of something like 40 miles an hour within that distance.

For this reason, I am inclined to think that the development of railway travel in the next century along the present lines will be not so much great speed as uniform speed. The ideal speed, I think, will be about 40 miles an hour and steadily maintained from the time of leaving one terminal to the time of the arrival at destination. That will give most satisfactory results. A steady speed of 40 miles an hour would enable a train to run from New York to Chicago in a little over 20 hours, and with greater economy and far less danger. It is my impression, therefore, that railway travel in the next century will take on this development rather than high rates of speed.

I am also satisfied that the immense cost of furnishing power for electric railways, which some persons seem to think can secure and maintain a speed of 100 miles an hour or more, will make such a development commercially unprofitable, although there is no doubt that electricity as a motive power for passenger traffic will be extensively used in the next century.

Laborers Arrested on the Charge of Breaking Ground and the Sabbath on the Same Day.

Last week there was great excitement in the usually quiet little town of West Pittston, Pa. It is a place of 5,000 inhabitants, mostly wealthy people. There are no saloons or cigar stores there. Sunday morning residents going to church were horrified to see laborers at work grading for a new electric railway. The citizens at once assembled in meeting, organized, and caused the arrest of 50 Italians. The station house was not large enough to hold them. A year ago the Town Council authorized the construction of a railway through the town. If the work was not done in a year the ordinance was to be rescinded. The year was up on Monday. On Saturday at quitting time 200 yards were yet unfinished, hence the trouble and anxiety of the railway company.

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The "bombshell" seems to have been a fire-cracker after all!

We have heard of a number of electric railway managers who are anxiously awaiting, with the gentle poet, the advent of spring in order to get in their fine work.

Again we would rise to remark to our esteemed, tan tinted, pentagonal contemporary, which knew so much about the Goebel lamp, that it is best "not to kno so much that ain't so."

Long distance telephoning has become a science on its own account, and has called into existence a class of operators who are valuable by reason of the clearness and sharpness with which they can pronounce words while speaking rapidly. It has also developed the fact that the French language is better adapted to the purposes of the telephone than the English. The ordinary business of the long distance telephone between Paris and London is carried on in the French language.

Well, how do you like this ELECTRICAL REVIEW? And, by the way, have we your name on our subscription books?

"The ELECTRICAL REVIEW is doing us good," writes a large machinery manufacturer. Of a truth, friend; egad! And why not?

Oh, what a year '93 will be! The lamp question is exciting, and there will be lots of fun in telephone circles after March 7. We are being mightily stirred up these days.

This St. Louis meeting of the National Electric Light Association will be a great one, but we must surpass it, if possible, by holding a convention during the World's Fair which will make our foreign visitors envious.

Mr. Grosvenor P. Lowrey's valuable article on the telephone, which appears on the opposite page, is a masterly and forceful presentation of interesting knowledge. The ELECTRICAL REVIEW deems itself extremely fortunate in being able to present to its readers a telephone story of such importance and value, especially as so much interest is centered on the expiration of the Bell patent next month.

We present in this issue an entertaining article on "The Place of Electricity in the Modern Office Building." The author of the article is the manager of one of the largest and best known office buildings in New York city, and is, besides, a man who keeps a tight grasp upon the general progress of affairs of the day. It will do us no harm to learn from time to time how we and our works are regarded from the layman's viewpoint, and in this instance we may read some interesting facts tersely told.

We are intending to spend a great deal of money during 1893 in pushing forward the ELECTRICAL REVIEW. We want to make it just as valuable as our constituents wish to have it, and to that end we have made unusual exertions to obtain new subscribers since January 1. We booked 197 new yearly subscriptions last week, and still they come. Every new subscriber adds to the influence and value of the ELECTRICAL REVIEW, so send yours along. We have several valuable surprises in store, and it will pay you to be with us. To both subscribers and advertisers we say, "Get aboard! Get aboard!"

A briefly worded pictorial review of the electrical advances and incidents of the year just ended in electrical circles, presented in this issue, will bring to every reader of the ELECTRICAL REVIEW a realizing sense of what they receive in 52 issues of this publication. A very small percentage of the entire matter published during the year is thus exhibited, yet it fills many pages and brings out forcibly and concisely the leading features of the year. It is likely the next year will be more interesting and more progressive, and the science will develop more rapidly than during the one just ended. The moral, if you wish to keep informed, is a simple one: Read the REVIEW.

The efficiency of synchronous systems is extraordinarily high. The efficiency of the Frankfort triphase system was between 68 and 75 per cent. excluding the losses in the motor; conceding the motor to have an efficiency of 80 per cent., the total efficiency between the driving and driven shafts was 56 per cent. In the synchronous system, admitting a 7 per cent. loss in the line, the efficiency between the driving and driven shafts would be about 75 per cent. The high efficiency thus possible with synchronous systems leads some engineers to warmly commend it. It presents the sole difficulty of failing to operate when the motor is overloaded, but as this may be provided for at the start, by giving it a capacity to meet the maximum load it must take care of, the system may yet meet with wide commercial introduction.

OURSELVES.

This Souvenir Number of the ELECTRICAL REVIEW will serve, it is hoped, to accentuate the sixteenth convention of the National Electric Light Association, and it also marks the beginning of the twelfth year of the ELECTRICAL REVIEW'S existence.

The *resumé* of the past year's electrical development, which will be found on pages following this, has been carefully prepared, although it presents but a minor portion of the whole year's work as chronicled in the ELECTRICAL REVIEW week by week.

We hope you will like this issue of the paper, and that the good reading it contains may be a profit and a pleasure to you.

THE LAMP DECISION.

Judge Colt's decision in the incandescent lamp case, rendered at Boston, on February 18, adds another victory to the long list already achieved by the General Electric Company.

In a special supplement, which forms a part of this number of the ELECTRICAL REVIEW, the decision will be found in full.

It is probable that a feeling of unrest will pervade the whole electrical fraternity until the General Electric Company closes up the last outside lamp manufacturer, or meets an obstruction which will overturn Edison's patent.

It is also probable that this legal struggle may last until the expiration of the patent in 1894.

THE GALVANOTROPIC CURVATURE OF CABBAGE.

Heretofore the all-conquering trolley has confined its interfering attentions to the telephone and telegraph, and, it is whispered, water and gas pipes; but now it seems possible that it may invade the province of the farmer and perhaps come somewhat under the genial control of Jerry Rusk, our hirsute Secretary of Agriculture.

It seems that certain enterprising vegetable physiologists have been experimenting upon the effect of the electric current on the roots of growing vegetables. It has been found that the passage of a certain amount of current through the soil about the roots of a cabbage, for instance, will cause the root to curve towards one or the other pole of the current generator. The beneficent possibilities of this action, which has been called "galvanotropism," have not yet appeared, and as the matter now stands our country trolley companies which use the earth as a return conductor would better prepare either to pay damages for deformed parsnips, or to send their electrical experts to take a post-graduate course in farming, so that if necessary they may be able for the benefit of the jury to clearly differentiate between the effect of hydrotropic and galvanotropic curvature of cabbage.

There are very few people who realize the possibilities of the long distance telephone service which is now gaining such a strong foothold in this country. As the net-work of wires is extended, so will the interchange of business contracts increase. Cities will be brought into closer relationship and all mercantile transactions will be consummated in a shorter space of time. More will, therefore, be accomplished and municipal improvements will grow in corresponding proportion.

Facetious people will claim now that a long distance telephone joins Chicago and Boston that Pork and Beans will have more re unions. But this is neither here nor there; what we feel sure of is that since this metallic weld has been consummated the people have felt as if the joining of all the principal cities of the world will be but a matter of time, and that among the many brilliant electrical minds that are coming to the front there will be one who will solve the problem of trans-oceanic telephony.

The business of making arc lamps for incandescent circuits is getting to be a big one.

You Can Talk With 125,000 Subscribers.

THE GREATER NEW YORK TELEPHONE EXCHANGE AND ITS FAR-SPREADING LONG DISTANCE CONNECTIONS.

How many people are there in New York to-day, even those having telephones, who realize that any telephone subscriber may communicate directly with 125,000 other telephone subscribers?

In New York city there are several small central offices connected together by trunk lines which collectively form the New York telephone exchange. Radiating from New York and extending to other cities, each having its own telephone exchange, are a large number of trunk lines. These cities occupy the same relative position to New York that the numerous central offices in New York occupy to the New York exchange. Inasmuch as it is possible for a subscriber in one exchange located in one city to communicate with a subscriber located in any one of the other cities connected, we may with propriety speak of the whole system as a greater exchange, and, as New York is practically the central office, speak of the system as the Greater New York Telephone Exchange.

It appears, then, that every subscriber in New York city or vicinity is one in an exchange of 125,000 stations.

The value of the telephone to a subscriber, as is well known by all users, depends, to a large extent, upon the size of the exchange of which it forms a part. In no other country than the United States has the combined effort of private enterprise and government control succeeded in building up a system of even one-half the size of the Greater New York Exchange.

When we attempt to trace the development of this gigantic system, we find its growth due to the magnificent system of trunk lines which have been constructed by the American Telephone and Telegraph Company, and which now connect together the principal cities in the United States, east of Chicago and Milwaukee, and north of Washington and Baltimore. The addition of every long distance trunk line increases the size of the Greater New York Exchange by the number of telephones in the district through which the trunk line extends.

The recent opening then of a number of the longest telephone lines in the world (and which were fully described in the ELECTRICAL REVIEW), have an interest to the public at large aside from their scientific interest to electrical engineers, because of the substantial increase which they make in the number of subscribers to the Greater New York Exchange. The public interest in these openings was well displayed when the mayors of New York and Chicago officially opened the lines between those two cities and the governor of Massachusetts opened the line extending from Boston to Chicago.

The opening of the line to Chicago has made Chicago a telephone suburb of New York in the same sense that Boston or Newark had been heretofore.

PERSONAL.

Capt. W. L. Candee, one of the American directors of the International Okonite Company, Limited, returned from Europe last week on the "Majestic."

Mr. R. T. McDonald is in New Orleans closing up the New Orleans street railway deal. The new company is organizing with a capital of $10,000,000, and it will be one of the most powerful electric traction companies in the United States.

Detroit Talks to Chicago.

On Saturday evening, February 18, the American Telephone and Telegraph Company opened its long distance telephone line between Chicago and Detroit. Officials of the company and invited guests were present at both terminals and the opening was, as usual, entirely successful. De Wolf Hopper talked amusingly over the line.

Electricity at the Press Club Fair.

TO THE EDITOR OF ELECTRICAL REVIEW:

Will you stop for a moment to think what wonders might be accomplished in electrical lighting and decorative devices at the great Fair for the Press Club Building and Charity Fund which is to be held during the month of May in New York? The preliminary plans indicate that this is going to be the most stupendous undertaking of its kind ever seen in this country. In many respects there is to be a departure from the methods which characterized the Actor's Fund, Masonic, Hebrew Orphan Asylum, and other great fairs held in the metropolis

The first notable departure from precedent is the selection of the building for the holding of the Fair, which, magnificent and notable though its advantages be, is almost entirely unknown to the public. A most liberal offer from the Madison Square Garden management was rejected, chiefly because Madison Square Garden was too small. The building selected for the Fair is, in point of floor area, four times the size of the great Garden, and its interior when completed, will be really a marvel in respect of size and architectural beauty. The building, which is in exterior a great red pile bounded by Forty-third and Forty-fourth streets and Lexington avenue and the Grand Central Depot, has cost, it is said, about $2,000,000 to construct. It is to be known as the Grand Central Palace. On the six great open floors of this structure there is over 240,000 square feet available for exposition purposes, and every foot of this will be used by the Fair managers.

The idea is just this: The New York Press Club is an organization of nearly 700 working journalists, whose records show that they have been, and are constantly, guilty of more genuine charity than any fraternal organization of a similar size in the world. Their charity is extended to worthy, distressed newspaper men and their families, whether they have any connection with the Club or not. Now, it is proposed to erect a home for the Press Club that shall be a credit to journalism and to the city, which at the same time will supply an income sufficient to establish a permanent charity fund to meet the many and increasing demands made upon this worthy organization. Generous citizens who have studied the needs of the Club have subscribed over $100,000 to the fund. A great deal more is needed, and that is why the leading newspaper workers of the metropolis have planned the greatest fair on record as a supreme money-raising effort. The indorsement of New York's most prominent citizens has been warmly given to the project, and the leading representatives of the stage, literature, music, art, trade and business of every kind have already offered co-operation that insures an exhibition of dazzling brilliancy. It is thought that not less than 200,000 people will see this great show.

Don't you think that you could stir up the geniuses in the electrical field to take an interest in this matter? I am sure that any assistance given to the Press Club in this project would be gratefully acknowledged and long remembered.

I might remind you that the Press Club includes among its members some of the best known and most highly respected journalists in the electrical field, such as: Geo. M. Phelps and Jos. Wetzler, of the *Electrical Engineer;* Chas. W. Price and Stephen L. Coles, of the ELECTRICAL REVIEW; W. J. Johnston, of the *Electrical World;* W. F. Osborne, of the *Western Electrician*, and others.

Yours very truly,

C. O'C. HENNESSY,
Gen'l Director Press Club Fair.

New York, February 18.

It is very probable that the discussion of the merits of the two sides in the recently decided electric lamp suit will be completely tabooed at the electric light convention, and while nothing will be said, a considerable amount of thinking will be indulged in.

THE TELEPHONE.

Its Legal History and Commercial Condition Presented by a Master Hand.

A MODEST CONFESSION—PRESIDENT ORTON OF THE WESTERN UNION BELIEVED DOLBEAR INVENTED THE TELEPHONE—EDISON'S IMPROVEMENTS — BOURSEL, THE FRENCH SOLDIER, AND HIS 1854 TELEPHONE — WHAT SCHOOL TEACHER REIS DID — HIS TELEPHONE OF '61 "COULD TALK, BUT WOULDN'T"—THE AUTHOR'S THEORY — EXPIRATION OF IMPORTANT PATENTS — BELL COMPANY'S GREAT STRENGTH—ENTRENCHED BEHIND, PROBABLY, 300 PATENTS, AND POSSESSORS OF THE FIELD—BERLINER'S PATENT AND THE ACTION TO ANNUL—INTERESTING HISTORY OF THE GOVERNMENT'S SUIT—ATTORNEY-GENERAL GARLAND'S VINDICATION—THE UNRELIABLE PRESS—"SPURIOUS EQUITY"—A LAW SUIT TOO BIG TO BE WON.

BY GROSVENOR P. LOWREY.

The Editor of the ELECTRICAL REVIEW asks me to write something upon the commercial and legal situation in telephone matters expected to ensue from the expiration, on the 7th of March, of the original patent granted to Alexander Graham Bell in 1876. That the subject is one of widespread interest is manifest. Persons

GROSVENOR P. LOWREY.

proposing to go into the business are busy in the effort to get information and advice. My part in the telephone litigation was short, comparatively inconspicuous, and not in the least degree successful; but, nevertheless, several people have asked my advice on points which show that there is a prevalent notion that after the date mentioned everybody will have the same opportunity to get rich in that business which Mr. Bell and his friends had.

My knowledge on telephone subjects was never thorough, but only such as an advocate gains for the temporary purposes of his cause. It is rapidly acquired, and as quickly forgotten. I hesitated, therefore, in responding to the request of the Editor, because the subject, and especially all those essential things which would be interesting, have largely passed away from me; and the labor of recovering them sufficiently to make even a respectable appearance before the readers of the REVIEW would be more than my time would permit. I cannot write a technical article which will point out how, and the degree to which, freedom to use one patented invention will open or fail to open the business to persons not controlling other patented inventions used in that business; and since I have no opinions to express on most of the topics which intending investors will wish to know about, perhaps the most profitable thing will be to recite a little of the history of the telephone as it still remains in my memory.

My first knowledge of any telephone was got when the Western Union Telegraph Company, through its president, Mr. Orton, entered into negotiations with Prof. Dolbear for his invention, as it had already or was about to acquire the inventions of Mr. Edison. Mr. Orton died in the belief that Prof. Dolbear was the true inventor of the telephone. That he was wrong must be assumed, because the courts have decided that Mr. Bell was the inventor. Mr. Edison did not claim to have conceived the original telephone idea, but to have made that idea more practicable by subsequent and subsidiary inventions. The idea of transmitting articulate sounds by means of the electric current is traced to Charles Boursel, a French soldier in Algiers, who, in 1854, published in a Paris journal his belief that a spoken word could be transmitted by electricity, saying:

"We know that sounds are made by vibrations and are made sensible to the ear by the same vibrations which are reproduced by the intervening medium. * * * * Suppose a man speaks in a moving disk sufficiently flexible to lose none of the vibrations of the voice; that this disk alternately makes and breaks the connection with the battery; you may have at a distance another disk which will simultaneously execute the same vibrations."

To make his idea elementarily clear, we have to conceive, of course, that the second disk is surrounded by atmospheric or other media, which is also in connection with the ear of a living being, and that the vibrations set up by the disk thus reach the hearing organ. For though sound physically is only certain to and fro vibrations in matter; physiologically, it is a sensation in some creature capable of the sensation. Boursel had made some experiments in this direction, and he says that the approximations obtained promised a favorable result. So far as I was able to learn, nothing more was ever heard from Boursel. But in 1861, Phillipp Reis, a school-teacher at Friedrichsdorf, near Frankfort, made an electrical instrument intended for the transmission of "all sounds capable of being perceived by the human ear;" and this was publicly described in an article entitled: "Telephony by Means of a Galvanic Current." The instrument was called by him a "telephone." The means of using it, and the details of its action, were set forth. The acoustical and electrical principles which were then and are now supposed to underlie the operation of every telephone were explained in this paper. That the apparatus succeeded well in transmitting the tones of various musical instruments, and the tones of the human voice in the singing of words, is undisputed. It was also shown in the argument before the Supreme Court, in the telephone cases of 1887, which began in January 24, and ended February 8, that Professor Quincke, still vice-rector, and actual head of the University at Heidelbergh; Dr. Rudolph Messel, who was a pupil of Reis; Johann Phillipp Schmidt, paymaster in the Imperial German Navy, a brother-in-law of Reis, and also a pupil in the school, and several others, did, on numerous occasions, hear this instrument reproduce articulate speech. The words which were received through it by Professor Quincke were repeated by him, although the form of his statement leaves it questionable whether the words which he heard were sung or spoken. If sung, it was possible that he may have been guided by the melody to recognize the words; and after a lapse of 14 years his memory may have confounded these things. This is what counsel for Bell said in reply to that testimony in their brief.

It was fortunate for the commercial interest of Bell and his associates that Reis undertook to explain the method of the operation of his instruments. He declared that sounds were transmitted by a making and breaking of the current, co-ordinate with the beginning and ending of vibrations due to each particular sound.

I was entirely satisfied previous to that argument that Reis was mistaken in his

explanation, and that no telephone, while operating by "making and breaking," could ever transmit articulate speech. I was equally satisfied that the 1861 instrument of Reis was mechanically capable of operating sometimes by the principle of "variable resistance," instead of the principle of "make and break," and that it was when it was accidentally operating in that way that Professor Quincke and others heard spoken words. The suggestion of a mode of operation was speculative merely, and passed without question, as it had been made without sufficient observation. Indeed, it is doubtful if at that time any test was possible. In our day even, the most ingenious contrivances have had to be devised to determine whether certain instruments when "talking" were making and breaking.

A man named Legat, who had some connection with the Austrian telegraph service, made a telephone in 1863, which was exhibited and shown by drawings in various scientific publications, and came to be known as the Reis-Legat telephone. That instrument possessed in a crude form the mechanical elements of a variable resistance telephone. That is to say, the connection between its parts over which the current must travel was capable of being adjusted by screw pressure so as to avoid altogether any such separation as would break the continuity of the current, while still permitting and favoring a constantly varying degree of pressure between the adjusted points, just as is done—though, on account of the material and better mechanical contrivance of its parts, in a vastly more perfect manner—by the Blake transmitter now used. It was a poor thing compared with the transmitter of to-day, but I cannot doubt the proofs, not only of persons who used it at that time, but also of highly respectable and reliable men of science in this country, who have heard it transmit speech during these later times.

One bit of evidence on this subject which never could be used in a court, but which was, to my mind, entirely satisfying on that point. About 1885 the Baltimore & Ohio Telegraph Company desired to apply telephone service to their entire telegraph system; and having been advised by electricians that a "make-and-break" instrument would suffice for the purpose, and their counsel, Mr. Latrobe, of Baltimore, being unable to satisfy himself that this would not infringe the Bell patent, the officers of the company, accompanied by Mr. Latrobe, came to me. One of the party was Dr. W. T. Barnard, assistant to the president of the Baltimore & Ohio Railroad Company, and a director and active manager of its telegraph company, now president of the elevated railway in Chicago. The matter about "make and break" and "variable resistance" was new to me. In fact, I had never looked on the inside of a telephone, nor had I up to that moment any but loose ideas as to how it operated. Naturally, the first step was to impress me with what was claimed for the "make-and-break" instrument; and one thing which impressed me was a statement by Dr. Barnard of his own experience with it. He had put a Reis telephone, made in exact conformity to Reis's drawings and descriptions in the journals of 1861, on the wire between his house, five miles out of Baltimore, and his office in the city. Efforts were made during a good many days to transmit sounds, and they were successful as to musical sounds—*i. e.*, sounds due to single harmonic or regular vibrations—but no articulate sounds—*i. e.*, sounds due to those irregular compound vibrations which represent all three elements of a compound sound, viz., its pitch, its intensity and its quality or "form"—were heard until one day, when by mere chance he was for a short time at the telephone. Suddenly a question which he asked seemed to have been heard by a member of his family at the house, and he received an intelligible response consisting of 10 or 15 words, recognizing the voice of the speaker. The thing then broke down and no other articulate sounds were obtained, though often tried for under precisely similar conditions, so far as they could determine. This seemed conclusive that "make and break" instruments could be made to transmit articulate sounds, and I did not then know enough about the subject to conceive any reason why they should not, with adequate skill in their construction and operation, always do it. What Dr. Barnard then said induced me to accept the duty of investigating the subject, with the view of giving a responsible opinion on the practicability and legal security of the B. & O.'s plan. A number of Reis instruments and others of modern make and break instruments were put into the hands of competent experts and experimenters. Some of them, men deserving and enjoying the utmost confidence, assured me that they had previously received vocal sounds by the ordinary Reis box telephone. I believed then, and still believe, what they said, but after some months of investigation, and after trying repeatedly myself at the Reis instrument, I was obliged to advise my clients to stick to the telegraph business and leave telephones alone. It was sound advice, as the event proved. So far as I could make out from the testimony, old and new, and my own experience, the Reis telephone could talk—but would not!

I had in the meantime learned, as I thought, the reason, which was, that occasionally, under accidental circumstances, so obscure as to escape observation, the original Reis instruments were liable for a short time to operate without completely breaking the circuit—in short, as variable resistance instruments; and that when they did "make and break," which was ninety-nine one hundred-thousandths of the time, they could not transmit electrical impulses similar in form—*i. e.*, with all the elements before alluded to—to the air vibrations accompanying sounds due to speech.

These reminiscences are of slight value, it is true, because the matter is now well understood. But, only a short time ago, it was the hope of a great number of electricians and mechanics to evade Mr. Bell's patent by an instrument, which should, in fact, make and break; and I suppose that a great many thousands of dollars, and time of equal value, have been wasted in that delusive effort.

On March 7, 1893, the first patent of Mr. Bell will no longer restrain any one from performing the operation described in its fifth claim, and I suppose the question which interests a great many minds now is whether that release from legal monopoly in the employment of that process will open the way to a profitable telephone business. This seems to be the point of interest for a variety of people who have visited me for information and advice.

Among them was a reporter for the New York *Times*. What I said to him in an offhand manner was published in his paper three or four weeks ago, and it is as good in a general way as anything that I have to say now. This reporter had the common idea that the present telephone monopoly rested solely upon Mr. Bell's patent. I called his attention to the fact that another very important patent of Mr. Bell's covered the receiver—that part of the telephone which is put to the ear—and that the patent on that did not expire, as I understood it, until 1894. I also called attention to the patents on the Blake transmitter, which some newspapers had spoken of as already expired. If I am not mistaken, the Blake transmitter is covered by a patent issued November 29, 1881, and a 17 year term would extend it to 1898. It is liable, however, to be shortened by a 15 year patent in Canada, and perhaps by a shorter patent granted in Italy in 1880, which may have a still shorter term. Of these particulars I have had as yet no occasion to supply myself with exact knowledge. I do know, however, that the telephone business is, as to its mechanical or scientific part, built up, not only on the process stated in and covered by Mr. Bell's fifth claim, but also a great number of other devices; and that besides these a great capital; organized modes of business; and established relations with most of the business community, have to be encountered by whoever intends to compete for anything but private line business.

As I have never had occasion to examine the details of a Bell central station, or the various things which, in the house of the customer, or the office of the company, are as essential as Bell's fifth claim to a good business, I cannot speak specifically; but it is my belief that whoever shall undertake to go into a telephone business on the expiration of Mr. Bell's patent will eventually find that the disappearance of the process of the fifth claim from among protected monopolies has not advanced him a single step, practically, towards ousting the Bell Company from any business requiring central stations.

With this view, and without any correction of the faults or errors due to colloquial statements, afterwards written out by a reporter (as he understands it), I give you what the *Times* reporter thinks I said:

While the expiration of telephone patents, viewed as a matter of current news, has some interest, it is not thought by those qualified to judge that the Bell Telephone Company has anything to fear from rivals. Grosvenor P. Lowrey, whose prominence in telephone litigation gives his opinions value, and who has figured always as an opponent of the Bell people, said Saturday night that he could not see that the present monopoly was in any danger. Its strength as a commercial organization had become so great, and its resources were so abundant, that he doubted if a new company could accomplish much by taking the field.

"Telephone service," he said, "is essentially different from any other undertaking, because, apart from the capital involved and the other resources at command, an old company has the subscribers, and they constitute the most important element in the service. Forty gas, water or light companies may lay pipes in my street, and I may be equally well served with gas or water or electric light by any of them. The value of a telephone in my house is based on the subscription list of the company. The instrument of a company with 1,000 subscribers is twice as valuable to me as that of a company with only 500 subscribers. An instrument becomes less valuable according to its inability to connect with some one that I want to reach.

"The Bell Company has all the subscribers now. Its equipment gives it the whip hand over any rivals who may appear. It can afford to cut rates and stand a siege much better than a new company. Some little saving might be made to subscribers by a rate war, but since subscribers order an instrument because of its connections, I should say that the present company would fight hard to prevent a newcomer from capturing those connections.

"In my opinion, the present company is much more firmly intrenched than the Western Union Telegraph Company. Any company can build telegraph lines to Chicago, and if I choose to send messages over a new line there is no reason why it should not serve me as well as the Western Union. But if I want a certain connection by telephone I must subscribe to the company having that connection, and a new company, even if offering cheaper service, must serve those with whom I wish to talk by telephone, or such service would not be cheap to me at any price.

"In regard to the expiration of patents, it is dangerous to assume too much. The Bell Telephone Company controls, I suppose, from 200 to 300 patents. Some of them are important adjuncts to the service. The instrument now in use in my house does not embrace a single patent taken out by Bell, except his fundamental idea. Some of the patents held by this company are new, and will be guarded carefully for many years. A long time ago the Bell Company bought out the interests of Berliner and Edison, then in litigation. I do not know that the Berliner patents have been extensively utilized yet, and I am of the impression that the claim is made for them that they establish anew, inclusive, fundamental and exclusive rights to things that telephone subscribers can't get along without. In other words, the present company seems so to have secured its interests as to make rivalry a dangerous undertaking."

I noticed yesterday in the newspapers, however, an interesting piece of news in respect to the Berliner patents, issued last year, and owned by the Bell Company. Much attention was drawn two or three years ago to proceedings in the Patent Office, by which Mr. Berliner's claim for a patent covering some of the material grounds, it was said, of Bell's patent, had been kept back by its owner, the Bell Company, without any reason whatever; and, finally, the patent was taken out so as to cover what Mr. Bell's patent had covered when the latter should expire. If true, as stated, the facts looked "shady." That such a procedure should excite public indignation, curiosity, suspicion—and, the facts being as alleged, eventually tend to destroy our system of patent protection under the law, is manifest. There is room for doubting that the press truly represented that business, in the fact that the conditions and circumstances of the company give it such preponderating advantages over any competitor that the sagacious men who control it would scarcely run the risk of increasing the great public rancor against them by such a course.

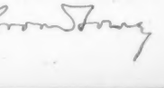
I was invited in 1885 or 1886, after the suit had been begun, to become counsel for the government in the suit brought by the United States to cancel Mr. Bell's patent. That suit was based upon allegations of fraud in obtaining the patent; the prior anticipation by Phillipp Reis—the overlooking of which was charged to be a public wrong and injury—and the anticipation by Drawbaugh, of Pennsylvania. When the bill, which had been drawn by other counsel, was submitted, Judge Thurman and I objected to certain allegations of fraud contained in it, unless we could be shown the proof by which they were to be sustained. It does not appear to me that I am improperly speaking of what occurred at consultations of counsel in saying that our views on that respect were adopted, and that, inasmuch as the persons who were relied upon to prove the fraud were not prepared at that time to exhibit that proof, those allegations were withdrawn, or, in a degree, modified, before we would consent that our names should be signed to the bill. The exploitation of the so-called Reis anticipation was put in my hands. When, in 1887, I had participated in the argument in the Supreme Court in the case of the American Bell Company *vs.* The Molecular Company, and several other cases (126 U. S.), and had said all I could in support of Mr. Reis' claim without succeeding in persuading a single judge—the judgment of March 19, 1888, unanimously denying the validity of the Reis telephone as an anticipation of Bell's fifth claim—I considered it my duty to represent to the present attorney general, Mr. Miller, that I did not see my way clear to be useful in that suit any longer; nor could I see any justification in continuing to take money from the United States in a case where I could not contribute to success.

Another unfavorable decision of questions arising on questions of pleading had been made on the question of fraud, in the case reported in 128 U. S., which I argued at the Circuit Court in Boston, but did not argue in the Supreme Court, because of absence from the country at the time. After a very full explanation of the situation under those two decisions, the attorney-general allowed me to retire, and I have had no knowledge of the litigation or of the views of the present administration on that subject since. It was, therefore, interesting to me to see by the papers of the 10th inst. that one of the ablest patent lawyers of the country, Hon. R. S. Taylor, of Fort Wayne, Ind., has been selected to file a bill on behalf of the attorney-general to set aside the Berliner patent, upon grounds of public policy, as I gather from the newspaper report. This confirms me in a belief formed after one or two conferences with Attorney-General Miller, that this administration concurs with that of President Cleveland, that such litigations should in proper cases be instituted, and that the general government has a duty to perform to the general public in respect of cases where patent office privileges are alleged to have been abused. I do not doubt that this case will have a thorough hearing and consideration.

I became acquainted very early with the persons, and, if I might so speak, with the influences which have pressed upon the government the public duty of taking up the charges against Mr. Bell in the first government suit; and I do not hesitate to declare that the "Pan Electric" talk of that time, and especially the insinuations against Attorney-General Garland and other public officials, in respect of that litigation, were as groundless and cruel as if I were to be charged to-day with having been interested in the Northampton bank robbery. The knowledge which I obtained, contrasted with things said with all appearance of circumstantial verity in the newspapers from day to day, have led me more than anything else which ever happened to lose confidence in what one reads in the papers. That the action of Mr. Garland was legitimate and proper—in short, that of a perfectly honest official and honorable man—that the action of the solicitor-general, Goode, was the same; and that President Cleveland did nothing more nor less than his duty, when, upon the case certified to him by the four public officers of the government, on whom the duty of investigating the charge was laid, he ordered the litigation to be prosecuted, could not fail to be clear to any rational person who should look into those matters with a desire—not to support a sensation—but to find out the truth. It was, therefore, interesting to hear that the present administration, which has continued to carry on that suit through its full term to establish the Drawbaugh anticipation against the Bell patent, has now caused a new prosecution to be instituted to set aside the Berliner patent.

The litigations to sustain Mr. Bell's patent were begun promptly, and were vigorously sustained by an expenditure of money, and of professional labor and skill never, I think, surpassed. The cases of infringement were all won, at every stage, without exception—that is, they were lost in the courts below by the side which I was afterward called on to represent in part in the Supreme Court. I thought I saw how a different result might have been attained earlier, and before the interest had become too great and too much diffused among innocent investors to be defeated. It is possible in legal controversies that the weight of interest on the one side or the other may become so great as to create a kind of spurious equity, which in some minds, and even very honest ones, has a tendency to obscure the strict legal right of the case. Whatever the original merits of a case, the execution of strict justice sometimes seems to threaten overwhelming and undeserved loss on one set of people without putting a penny in the pockets of the other; and it takes a very cold-blooded and clear-headed judge to withstand the humane sentiment which presses upon him in such a case. I am satisfied that there are some lawsuits too big to be won; and the Bell telephone controversy between private parties had attained that prohibitive size before it reached the Supreme Court.

Feb. 10, 1893.



ONE YEAR OF ELECTRICITY.

Valuable Gleanings from the Rich Harvest Garnered by the "ELECTRICAL REVIEW" During the Past Twelve Months.

PROGRESS IN LIGHTING, TRANSMISSION OF POWER, RAILWAYS, HEATING, COOKING, WELDING, TELEGRAPHY AND TELEPHONY.—THE INCANDESCENT LAMP CONTROVERSY.—THE GOEBEL SURPRISE.—THE STOPPERED LAMP.—NIAGARA FALLS PLANT.—THE TELLURIDE TESLA SYSTEM.—LONG DISTANCE TRANSMISSION BY DIRECT CURRENT.—ALTERNATING CURRENT MOTORS.—MINING IMPROVEMENTS.—UNDERGROUND RAILWAYS.—LONG DISTANCE TELEPHONY.—DEATH OF EMINENT ELECTRICAL WORKERS.—THE PATENT OFFICE.—A LITTLE OF THE HUMOR OF ELECTRICITY.

INTRODUCTION.

WHILE the year which closes with this number of the ELECTRICAL REVIEW has not been characterized by the production of any of the marvels in which the electrical prodigy has been so fruitful, it bears evidences of a steady march of improvement, signalized by the introduction of more perfect apparatus and an expansion of the field of application for electrical inventions the birth of which occurred at an earlier date. We shall examine briefly these various steps of progress in the present article, and spread before our readers as concisely as possible a panoramic retrospect of the scientific treat which has been afforded the readers of the ELECTRICAL REVIEW during the eleventh year of its interesting history. The electrical art has long ago challenged the attention of the brightest minds engaged in industrial and scientific work, and, while doubtless there are still problems that will be solved by its assistance which will seem marvelous when their results have been attained, it is tolerably certain that the number of such instances will be comparatively small. The growth of electrical science will principally lie in a more perfect development of inventions already made, in the attainment of increased efficiencies and the simplification of construction and enlargement of their scope of application. And so it happens that in examining the record of the year just closed we shall find that the progress, although steady, has fallen more especially in commercial than in inventive lines. We would not be understood as implying that no important inventions have been the outgrowth of the past year, for there have been many such, a number of which will be noted in the present discussion; but the greatest progress has been in commercial and scientific directions.

A MODERN ENGLISH PLANT.—INTERIOR VIEW OF ST. PANCRAS, LONDON, CENTRAL STATION.

ELECTRIC LIGHTING.

We will first glance at the electric lighting industry. One of the chief events of interest in this branch during the year has been the decision reached in the protracted legal controversy over the basic patent on the

INCANDESCENT LAMP.

The suit was based upon patent number 223,898, issued to Thomas A. Edison in 1880. The efforts of others in the art prior to Edison's advent, notably Dr. Adams, who made experimental lamps; Crookes, who made radiometers and other devices enclosed in high vacua; Star, Roberts, Woodward, Farmer and others, it was contended by the litigants who sought to upset Edison's patent were sufficient to invalidate that instrument. This contention was met by those endeavoring to support the patent by the assertion that, prior to the construction of the Edison lamp, no filament of carbon properly called a filament had been used in an all-glass globe from which the air had been thoroughly exhausted, and it was urged that Edison's efforts had achieved success, whereas all the prior efforts to produce an incandescent lamp had led to failure. The court, in making this decision, sustained the patent and gave it a broad construction, covering a carbon filament in an all-glass vacuous globe, provided with conductors leading through the glass. One result of this decision was to lead to the introduction of a distinctly different type of incandescent lamp by the Westinghouse Company, in which a glass stopper, carrying a filament, is accurately fitted to the stem of the bulb, the joint being sealed with a suitable paste. Arrangements have been made to produce these lamps in large quantities, and it is probable that they will go into an extensive use, especially in view of Judge Colt's decision in the United States Circuit Court, at Boston, enjoining the Beacon Vacuum Pump and Electrical Company from manufacturing lamps. The defense brought by the Beacon Company was a great surprise to the electrical fraternity. Affidavits were presented before Judge Colt, in Boston, claiming that incandescent lamps precisely similar in all material points of construction to the Edison lamps now made were made and used by Heinrich Goebel, an ingenious, scientific mechanician, who came to this country in 1848, and carried on a business of repairing watches, and devoting all the leisure he could find to scientific experiments.

THE GOEBEL LAMP.

Mr. Goebel, who is now upward of 70 years of age, it was claimed had used lamps before the late civil war precisely like those now in use on lighting circuits. He is said to have used them to attract the attention of passers-by in Union Square, New York, to a telescope with which it was his custom to give nightly exhibitions of the heavens. Judge Colt decides that these lamps of Goebel's were "experimental toys," and not a practical invention. It is asserted by the Edison interests that Mr. Goebel's claims were brought to the notice of the Edison Company as early as 1882, and were turned down as lacking substantial foundation. It seems strange that an event of such great importance, and one in which there was a universal public interest, should not have met with a wider notice at the hands of the press of the metropolis, and that Mr. Goebel did not, during the long period of alleged exhibition of his lamps, find someone who would recognize the importance of his achievement; and although the dynamo as an economic generator was not generally understood at the date claimed for Mr. Goebel's inventions, it seems reasonable to expect that, when the world was ringing with the praise of Edison for the great achievement of incandescent lighting, the persons who are alleged to have known of Goebel's operations would have stirred up in his interest an influence which would have pressed his claims as a rival of Edison, at a time when they would have been more likely to result in his financial interest. It seems also strange that in the exhaustive investigation made by the able experts and attorneys who attacked the patent Mr. Goebel's claims should not have been brought to light. The patent had been attacked on every conceivable ground, such as the expiration of foreign patents, obscurity of description, change of ownership such as might defeat the suit, failure to bring the suit until large amounts of money had been invested by other companies in the manufacture of lamps, lack of infringement, etc., yet the final court of appeals sustained the patent, paraphrasing the disputed claims, as follows: "The combination of carbon, filamentary or threadlike in size and properly carbonized, used as an illuminant in an incandescent electric lamp, with a receiver made entirely of glass and conductors passing through the glass, and from which receiver the air has been exhausted to such an extent that disintegration of the carbon, due to the air washing action of surrounding gases, or to any other cause, is so far reduced as to leave the carbon practically stable." In view of Judge Colt's decision, rendered at Boston, on February 18th,

the right to manufacture incandescent lamps having a filament sealed in an all glass vacuous globe is still the exclusive property of the General Electric Company.

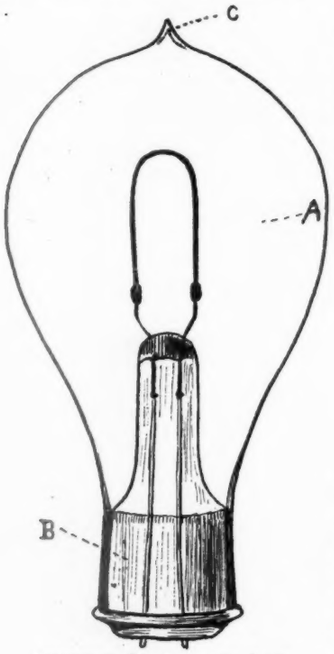
THE WESTINGHOUSE LAMP.

The lamps produced by the Westinghouse Company are interesting, as showing what may be accomplished under stress of circumstances.

It is claimed that these lamps not only work satisfactorily, although they are provided with a stopper, but that the latter is a positive advantage, by reason of the separability of the parts and the ability to replace a fresh filament in a bulb when an old one has reached the limit of its service.

BUOY LIGHTING.

An interesting application was described early in the year, showing a successful application of electric lighting to buoys. The cuts which are herewith presented are almost self-explanatory, showing the construction of an electrically lighted buoy situated in Gedney's Channel, off Staten Island, a distance of about 6,000 feet. The buoy is provided with an iron cage enclosing a heavy glass jar containing a 100 candle-power lamp, the current for lighting which is brought through a heavy armored cable from the buoy station. In a related line of improvement is the submarine search-light,



STOPPERED INCANDESCENT LAMP.

which is now liberally used, and several illustrations of which accompany this article.

ELECTRIC LIGHT BATH.

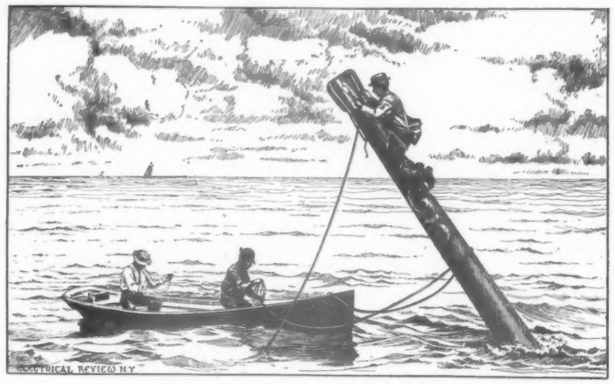
A rather novel application has been given electric lamps in arranging them in banks on the interior of a cabinet, called an "electric light bath." A person seated within the cabinet is exposed to the radiant heat of the lamps at all points except his head. The lamps are so distributed that the heat will be substantially uniform, about 60 lamps of 16 candle-power each being used in the cabinet. It is said that the temperature of the patient in 10 minutes rises to 148 degrees, and that the light of the bath has the effect of browning the skin in a manner similar to the seaside sun.

COMMERCIAL ELECTRIC LIGHTING.

On the commercial side of electric lighting much has been done in the way of introduction of new electric lighting plants and the organization of new electric lighting companies. A brief pictorial glimpse is presented of a few of the central station outfits installed during the year.

The Saint Pancras, London, electric light station is one of the best governed in the British metropolis. It has a capacity of 10,000 incandescent lamps, with an ultimate capacity of 27,000 lamps, and furnishes about 100 high tension 10 ampere arc lights. The dynamos are directly driven by several triple expansion engines. The plant is provided with ample storage battery capacity, which serves as a reserve during periods of minimum demand. It supplies a dense business neighborhood and a large number of private residences.

Another interesting plant illustrated is that of the Municipal Lighting Station at Easton, operated by two 200 horse-power engines of the Henry Doty "B" type, having cylinders of 18 inch diameter and 28



TENDING AN ELECTRIC LIGHTED BUOY.

inch stroke, and running at 170 revolutions per minute. Steam is supplied by a 400 horse-power Wainwright heater, accompanied by a Weitemeyer gas and smoke-consuming furnace.

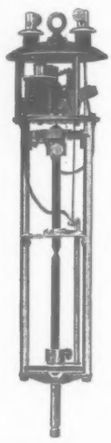
Another view is presented of an interesting plant at Waterbury, Conn., operated by three Corliss engines, one of 200 horse-power and two cross-compound engines of

MCCREARY REFLECTOR FIXTURE.

400 horse-power each, the system being provided also with an auxiliary Ball engine of 100 horse-power. Current is furnished by four No. 20 and six No. 10 Edison direct current machines of the three wire system, having an aggregate capacity of 3,500 incandescent lights and one 1,000 and one 1,300 Thomson-Houston alternators, and nine Thomson-Houston arc light machines, each supplying 25 to 50 lamps. The total capacity of the plant is about 335 arc and 6,000 incandescent lights.

Attention in passing might be called to the Manhattan Electric Light Company's new switchboard, illustrated in the sketch presented herewith, which represents in front of the board an attendant in the act of plugging into a "bus" bar. The board is built for 1,000 volt, 10 ampere dynamos and 17 circuits, and has a total length of 16 feet. The entire front of the slate is marbleized. All electrically connected metals behind the board are insulated with hard rubber. Any circuit can be placed on any machine. Two pairs of plugs, with black and red handles, respectively, are provided, one pair of which is always idle. The idle pair of plugs may be handled as desired, independent of the fact that the current is in operation.

In arc lighting notice may be made of the Thomson-Houston ribbon feed lamp. The lamp is adapted for indoor lighting and is capable of being used on either arc or incandescent lamps. It is 24 to 27 inches from top to bottom, 6 inches wide and weighs 21 pounds without the globe. The mechanism is carefully protected from dust, and the regulation is admirable in preserving the arc of uniform length, giving a steady, brilliant light, free of hissing. On incandescent circuits they run in multiple branches, two to each branch, a small rheostat or bank of incandescent lamps being used as a controlling device.



THE "HELIOS" ALTERNATING CURRENT ARC LAMP.

DIVER WITH SUBMARINE ELECTRIC LAMP.

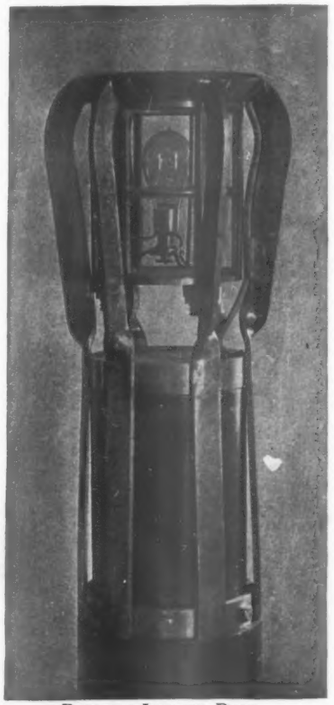
Worthy of note are the beautiful and artistic designs for interior lighting presented by the Electric Construction and Supply Company, New York, of the Ward arc lamp. These lamps admit of being used with low ceilings and will burn 6½ hours, using a ⅝ inch carbon for the top and a 1⅞ inch carbon for the bottom. These lamps are made almost entirely from brass castings and present a rich and imposing appearance.

Attractive illustrations are also presented of the new and very ornamental arc lamp made by the General Incandescent Arc Light Company, of New York. These lamps are made in highly artistic designs, possess many improvements, and, having been recently introduced, are attracting a good deal of attention. The strongest claims are made for these lamps, particularly as to economy, and as the well-known manufacturers, Messrs. S. Bergmann and P. H. Klein, Jr., are at the head of the company, its success is assured.

The problem of providing an alternating arc lamp with perfect regulating mechanism and freedom in operation from the disagreeable high-pitched singing, has been a serious one. The "Helios" alternating arc lamp aims to meet all requirements. A cut is presented showing such a lamp. The carbons are both fed toward each other, being suspended from a cord passing over a pulley controlled by the regulating mechanism. The lamp is based upon a patent of Coerper, a German electrician.

WORLD'S FAIR GENERATORS.

Electricity will cut a very important figure at the World's Fair. An engraving



ELECTRIC LIGHTED BUOY.

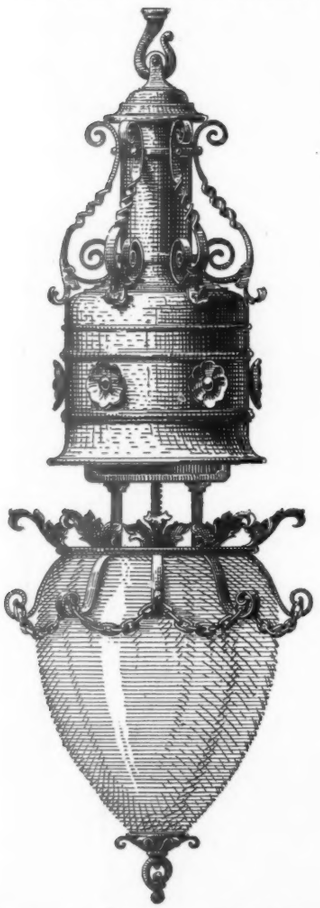
is presented herewith of one of the 15,000 sixteen candle-power generators furnished by the Westinghouse Electric & Manufacturing Company for the World's Fair, each of which weighs 75 tons, stands about 20feet high, and requires a 1,000 horse-power engine to drive it. The armature is about 90 inches in diameter, weighs 4,500 pounds, and makes 260 revolutions per minute, the driving belt being 34 inches wide. The contract for lighting the World's Fair covers a minimum of 92,000 sixteen candle-power lamps. Twelve of the large generators above referred to will be furnished, six being connected directly to the engine shafts, and six being belt driven. The total horse-power of the engines will aggregate 12,000, greatly exceeding the capacity of any lighting station in the world. It is expected that 92,000 of the new stoppered incandescent lamps will be in use at the exhibition on its opening, and that at least 30,000 more will be used by exhibitors.

LIGHTNING ARRESTERS.

Several interesting inventions in lightning arresters have been developed during the year. One of the most remarkable in its method of operation is the Wurts lightning arrester, two views of which are presented. The operation of Mr. Wurts's device depends upon a property discovered by him

possessed by certain metals of the zinc and antimony group, such as zinc, cadmium, mercury, magnesium, antimony and bismuth, by which, when an alternating current arc is sprung between two electrodes of these metals over a short air gap, such an arc will not be maintained, although the current may be continued.

The Thomson lightning arrester is also worthy of note as comprising several interesting and novel features. In this device the arc is blown out by magnetism. Two confronting pole pieces of a permanent magnet are provided with a series of mica vanes placed radially across the space between the poles. Discharge points are placed in the middle of the pole pieces, so as to be in the center of the magnetic field. When the discharge occurs the field repels the arc between the discharge points, which is broken up by the mica vanes as it spreads radially outward.



General Incandescent Arc Light Company's Ornamental Lamp.

GENERAL MENTION.

The Ries regulating socket is an interesting invention in alternating incandescent lighting, inasmuch as it enables an incandescent lamp to be maintained at different degrees of brilliancy, according to the desire of the user, with a corresponding economy in the consumption of current.

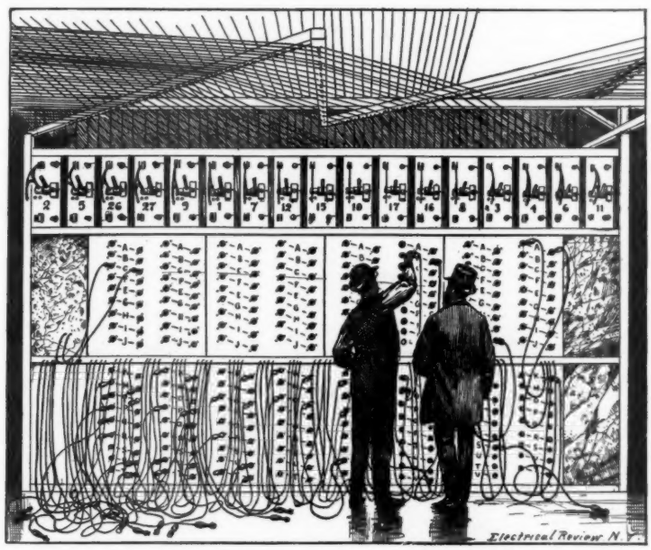
In another figure is shown an interesting design presented in the De Khotinsky icicle lamp, so-called from the resemblance of its globe to nature's product.

A patent of some interest was issued during the year that seemed from its apparent scope to have an important bearing on the lighting industry. It was issued to Deprez and Carpentier. This patent was based upon an old French patent issued in 1881, which was exhumed for the purpose of putting upon it a modern interpretation, and apparently making an effort to control the art of alternating incandescent lighting. The construction upon which the patent was based was simply two induction coils provided with a buzzer for interrupting the circuit, and a connecting line between the induction coils, one being used to raise the tension at the transmitting end of the line, and the other to lower the tension at the receiving end of the line. The patent was issued with high sounding claims, which seemed to cover the use found in the last few years for the "step-up" and "step-down" transformers in alternating lighting. No effort nas been made, as far as we are aware, to enforce the patent and enjoin those whose energy has achieved practical success in alternating current lighting.

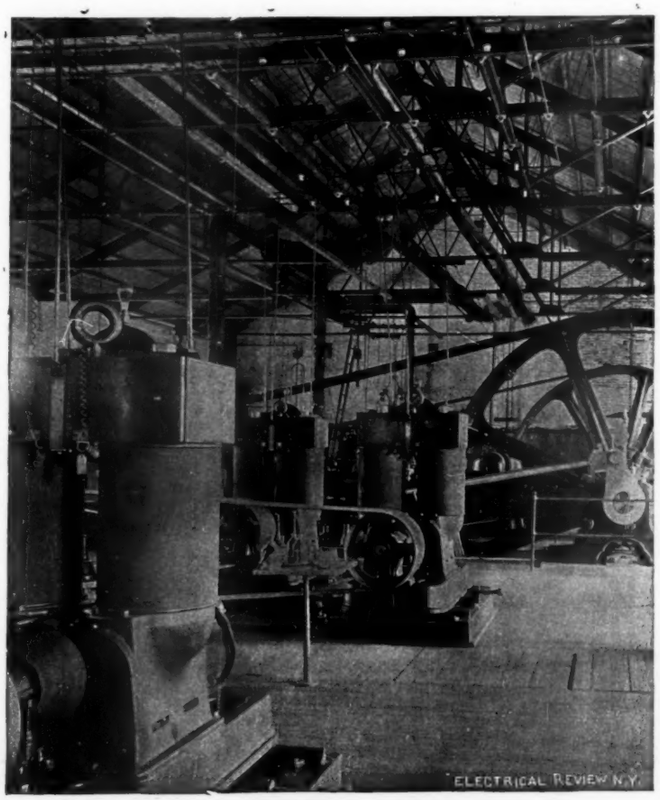
A novel safety fuse is shown and was patented during the year, known as the Wotton safety fuse, in which an explosive substance, such as gun cotton or fulminate of mercury, is enclosed in a short cylinder of copper, connections being made with the circuit through the ends. Upon an increase of current strength the cylinders heat and ignite the explosive and disrupt the circuit.

The McCreary reflector, a cut of which is presented, is a recent novelty. Incandescent lamps are equipped with an aluminum half shade, which can be moved round the lamp at will, throwing the light in any direction. The whole arrangement is ornamental and inexpensive. The reflectors are sometimes formed of other materials, such as silver, opal or crystal, and produce pleasing and useful effects.

There is illustrated an apparatus used by Prof. Elihu Thomson in experimenting with alternating currents of high frequency. Professor Thomson found that with a condenser placed in a secondary circuit and a spark gap between two electrodes in the same circuit he could, by discharging an air blast against the spark gap, increase the frequency of alternation. By carrying this secondary round an induction coil immersed in oil, and raising the tension by a tertiary circuit, he obtained sparks of great length. By passing a current of 80 volts through the primary circuit and transforming it up to 10,000 or 12,000 volts, sufficient to maintain a half inch spark in the air gap, and carrying this current through 15 or 20 turns, in the final transforming coil, round which was wound 120 turns as the tertiary circuit, he was enabled by the air blast to produce eight inch sparks in the tertiary circuit. Sparks almost three feet in length were produced by a similar organization of apparatus. The enormous frequency of the finally transferred current is shown by the fact that a lamp fed by the final circuit will be illuminated although shunted by heavy copper wire at its terminals. As far as we are aware, no practical application of this method of raising the frequency of an alternating current has yet been made.



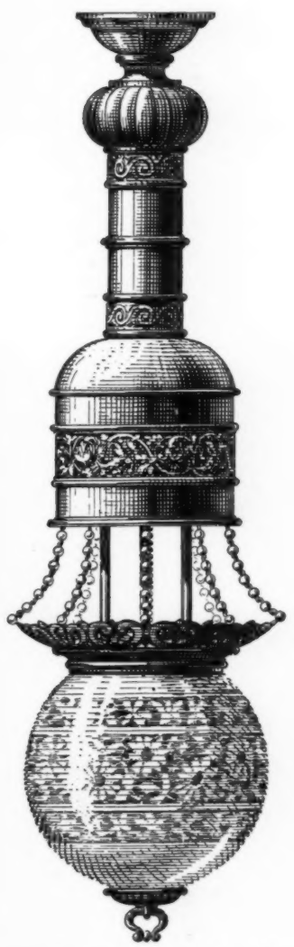
Switchboard at Manhattan Electric Light Company's Station, New York City.



Interior View of Waterbury, Conn., Electric Light Plant.

The novel system of polyphase alternating current distribution, which was practically operated in the transmission of power plant between Frankfort and Lauffen, has received considerable development during the last year in this country. A lighting system has been designed specially applicable to the triphase system, wherein a house wired for the ordinary three wire direct current system may be utilized for the new system and either triphase motors or lamps may be applied as may be needed.

M. M. M. Slattery, whose name is intimately identified with the growth of alternating current lighting in this country, died during the year. Mr. Slattery had taken out a considerable number of patents in the art and had been for a long time identified with the Fort Wayne Electric Company. We are indebted to the *Western Electrician* for the portrait of Mr. Slattery which appears on another page.

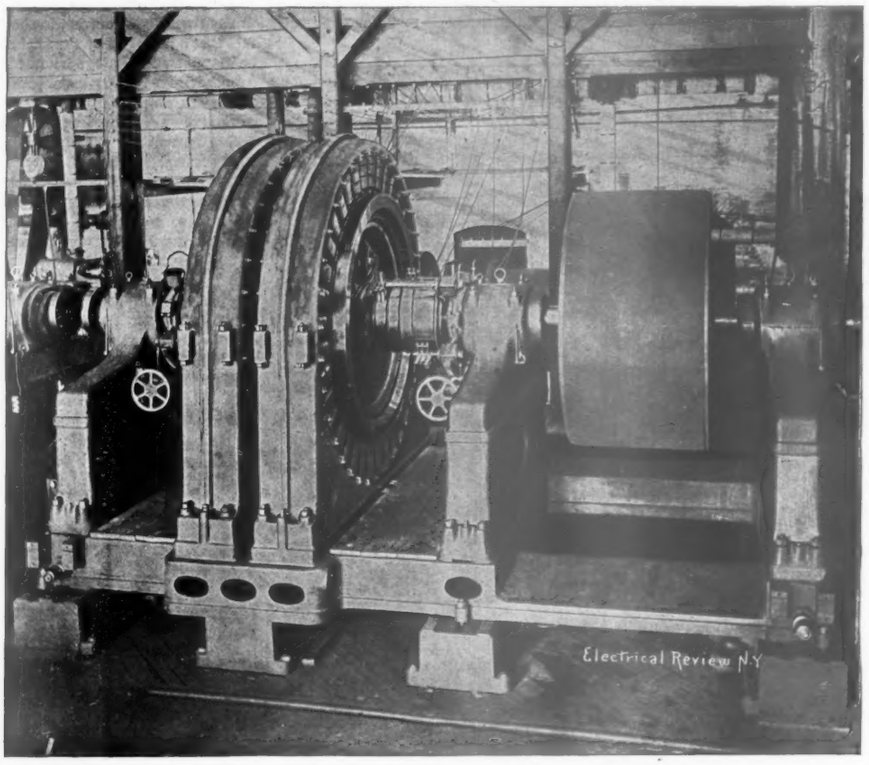


General Incandescent Arc Light Company's Ornamental Lamp.

TRANSMISSION OF POWER.

In the electrical transmission of power, the year just past is as notable for the progress made as for its augury of greater progress in the near future. This is one of the most fascinating branches in the whole electrical industry, and one which promises

a wide range of application. Electrical transmission of power is the cheapest mode of conveying large units of energy over a long distance, and its economy and ease of manipulation promises for it a liberal commercial use. The success of the Frankfort



ONE OF THE 15,000-LIGHT WESTINGHOUSE GENERATORS FOR THE WORLD'S FAIR.

experiment, the report of which was made public during the year, has established for the multiphase system of power transmission a high reputation. The official report of

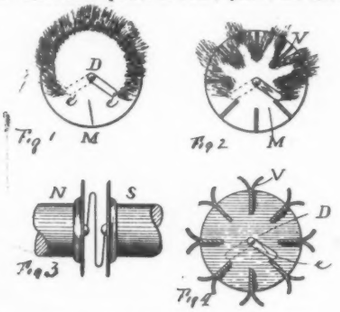
limits of $68\frac{5}{16}$ and $75\frac{3}{16}$ per cent. Counting the losses in the motor, the efficiency was not so high as this, but was still sufficient to place the electrical transmission of large powers over long ranges on a plane where it will have no competitor. The loss of energy in the generator was about 10 per cent., the generator delivering 108 of the 120 horse-power delivered to it. The loss in the transformer at the generating station was about 5 per cent., the loss in the line

transmission by the use of electricity over long distances, a success destined in the end, it is believed, to revolutionize to a considerable degree present industrial methods.

It is probable that the triphase system or some other form of polyphase system of transmission of power will be adopted in the power plant under construction at

NIAGARA FALLS.

Progress in that enterprise has been steadily advancing during the year, and where



THOMSON'S LIGHTNING ARRESTER.

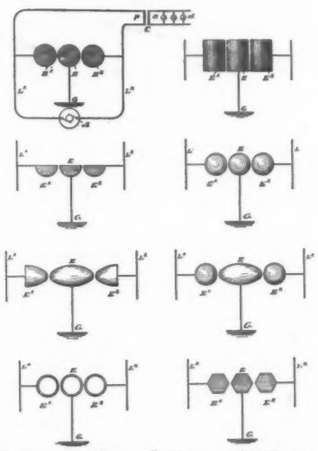
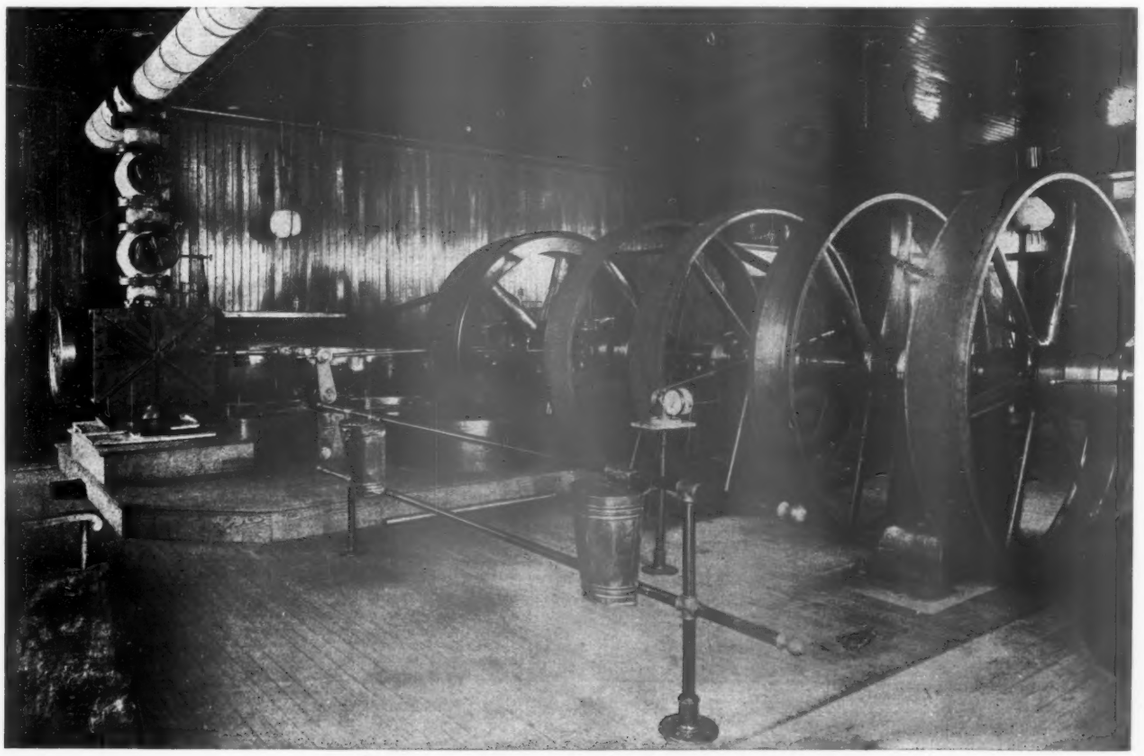


DIAGRAM OF WURTS' LIGHTNING ARRESTER.

are now being entertained as to the best electrical method for converting this power and transmitting it to the various points where it is proposed to utilize it. The rates proposed will be $10 per horse-power for 5,000 horse-power or over; $10.50 for 4,500 horse-power; $11 for 4,000 horse-power, and so on, down to $21 for 300 horse-power; all these estimates being based upon 24 hours' daily use of the current if needed. These



INTERIOR OF EASTON, PA., MUNICIPAL LIGHTING STATION.

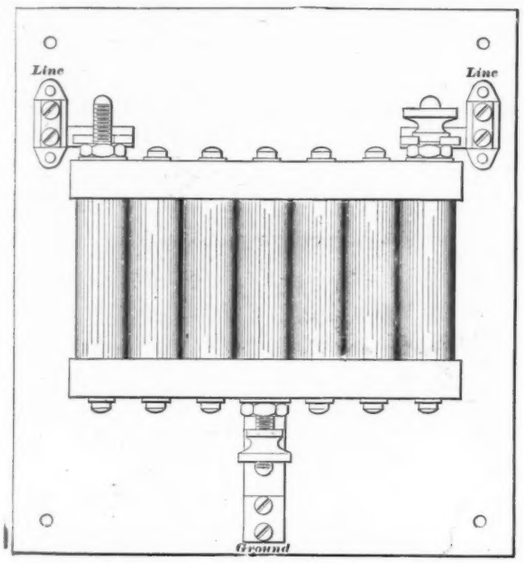
THE FRANKFORT EXPERIMENT,

Made public in August, showed that the efficiency of the Frankfort system between the turbine axle at Lauffen, which was the source of power, to the motor at Frankfort, 108 miles distant, fluctuated between the about 7 per cent., and the loss in the transformer at the receiving station about $5\frac{1}{2}$ per cent. The result attained in this experiment surpassed the most sanguine expectations of its promoters and removed any doubt as to the practical feasibility of power

two years ago was a cornfield is now a canal feeding the wheel pits of the tunnel. In the plant on the American side there will be about 125,000 effective horse-power, the water being led to the turbine through a tunnel 6,700 feet in length. Propositions

rates may be contrasted with the expense of steam power for a 10 hour day, ranging from $25 to $40. Most of the power developed on the American side will probably be utilized in manufactories in the immediate neighborhood. A power system, however, is

proposed for the Canadian side, in which it is proposed to develop a voltage of 25,000, and maintain 100,000 horse-power at an 800 foot tunnel on the Canadian bank. Part of this will be transmitted to Buffalo, which is closer to the proposed Canadian wheel pits than to those now about completed on the

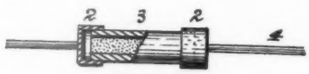


COMMERCIAL FORM OF WURTS LIGHTNING ARRESTER.

American side. Part of this power will be utilized for operating electric railways in towns in the neighborhood of the Falls. While the polyphase or differential phase system of transmission has been much discussed, by reason of the success of the Frankfort plant, it is possible that the direct current will come into competition.

THE DIRECT CURRENT FOR LONG DISTANCE.

A plan recently proposed and described in a late number of the ELECTRICAL REVIEW provides for the development of direct current of high tension by means of a large number of independent generators highly insulated from one another and from earth coupled in series. The generators are only



WOTTON'S FUSE.

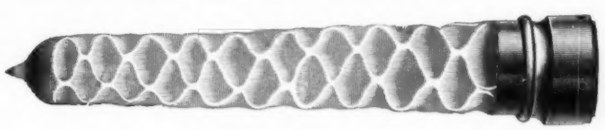
accessible by means of a glass platform, to reach which an attendant must mount a series of steps, and in order to make the operation of the system entirely safe, both for the machines themselves and for the operators, the line is electrically connected by a substantial copper connection with the

MCCREARY'S REFLECTOR AND STAND.

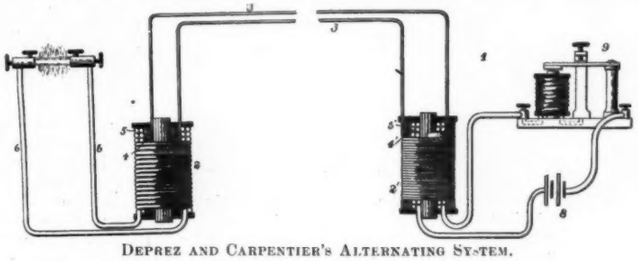
base of the several machines, so that in case of a possible ground, a line fuse will be blown, and the safety of the machines insured, and all risk to the operator avoided. By means of coupling the several generators in series and using as many as may be required for the voltage needed, the electromotive force of any given machine can be reduced to a safe working limit. Say each machine delivered an electromotive force of 500 volts, and 15 machines were employed, an aggregate electromotive force of 7,500 volts would be delivered at the line terminals, and yet the difference of potential between any pair of generator brushes would be simply 500 volts. Thus but little dielectric strain is imposed upon the windings of any machine, and the system is brought within the range of commercial feasibility. With this system it is probable that the generator station will be operated as a unit, all of the generators being coupled to a common driving shaft, and similarly, at the delivery end of the system, all of the motors will operate as a unit and act upon a common driven shaft, which in turn can be utilized to operate other generators and supply local distribution circuits. The ultimate results of these great advancements in power transmission and distribution are difficult to conceive. Not only will power be cheapened for large consumers, but the delivery of small units of power to individual consumers will be rendered possible, a feature which may have a very important effect on our social and industrial system.

THE TESLA SYSTEM.

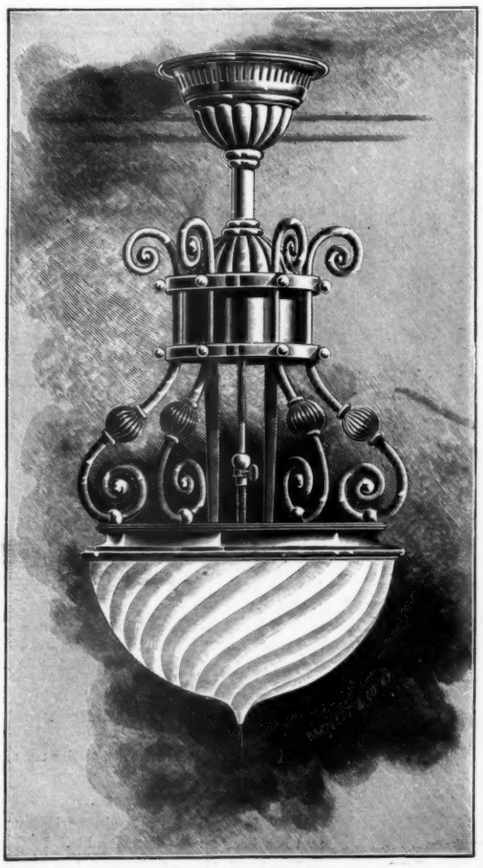
A very interesting system of power transmission, by means of alternating currents, is the Tesla plant installed at Telluride, several engravings of which are herewith presented. A Pelton water wheel, driven under a head of 320 feet and fed by a steel pipe, drives an alternating current generator, and the current is transmitted over a bare wire to a stamp mill three miles distant, and drives an alternating current synchronous motor of 100 horse-power. Part of the generator field is excited by a direct current from a separate machine, the rest of the current being supplied from the generator armature commutated to a direct current by a two-part commutator. The adjustment is such that the electromotive force of the main terminals rises as the current delivered by the machine increases, preserving the pressure at the motor terminals at 3,000 volts. The speed is 880 revolutions per minute, giving 10,000 alternations. The motor is similar to the generator, except that the field current is obtained, not from a separate machine, but from a second winding parallel with the main coils around the teeth of the armature, which is suitably commutated for the field circuit. The motor runs in synchronism with the generator, and a starting motor built on the Tesla quarter-phase plan is provided for bringing the motor up to synchronism on starting. This starting motor is provided with a laminated field with inwardly projecting poles and a closed coil armature, no commutator being used. It comes quickly to its normal speed, and brings the armature of the synchronous motor quickly up to, and a trifle above, synchronism when the field of the large motor is excited, after which the latter falls into step with the current supplied from the generator, the starting motor being then cut off. The efficiency of the synchronous motor system, leaving out the loss in conductors, but including the losses in generator

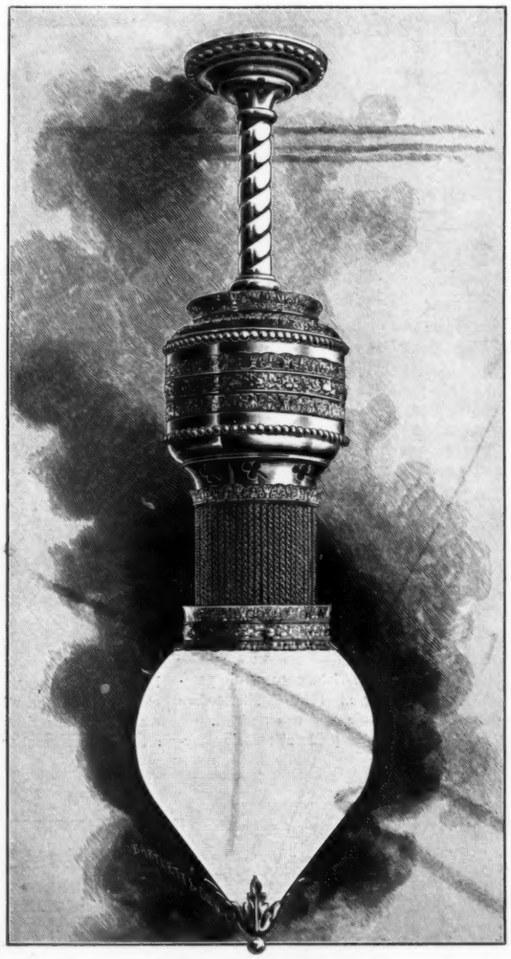


DE KHOTINSKY'S ICICLE LAMP.



DEPREZ AND CARPENTIER'S ALTERNATING SYSTEM.





"WARD" ORNAMENTAL ARC LAMPS.

and motor, was found to be 83½ per cent. at full load and 74 per cent. at half load. Several views, presented herewith, will give a graphic idea of this system. The pole line runs from the power station up the mountain

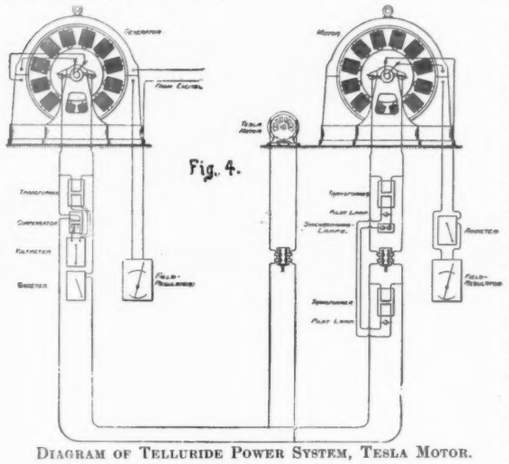
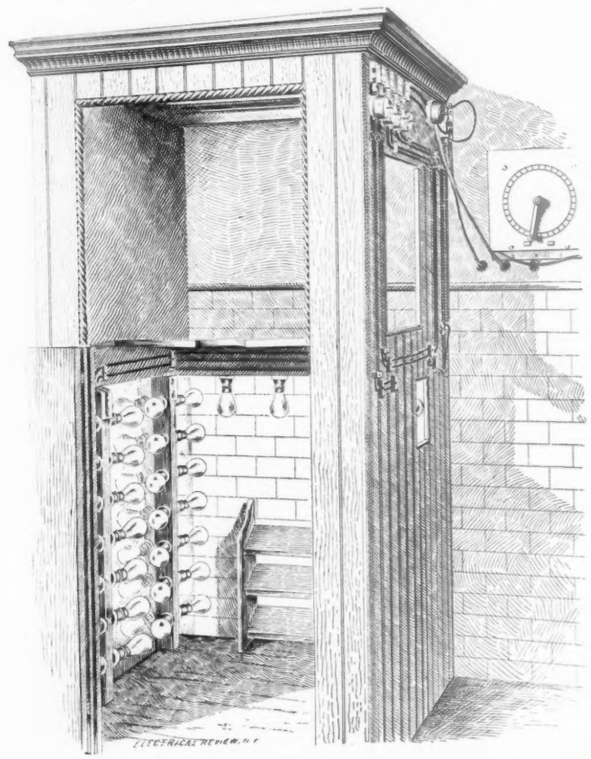


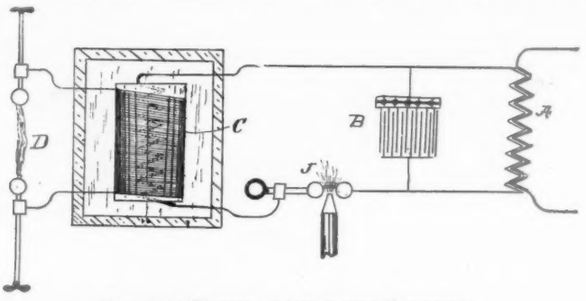
DIAGRAM OF TELLURIDE POWER SYSTEM, TESLA MOTOR.

to a height of 125 feet, and then across a rough country to the mill. Many of the poles are set in solid rock. Snow in winter is sometimes level with the tops of the poles. The capacity of this system will be largely increased as a result of its successful operation, and lighting at Telluride, heretofore done on a small scale, will be extended.

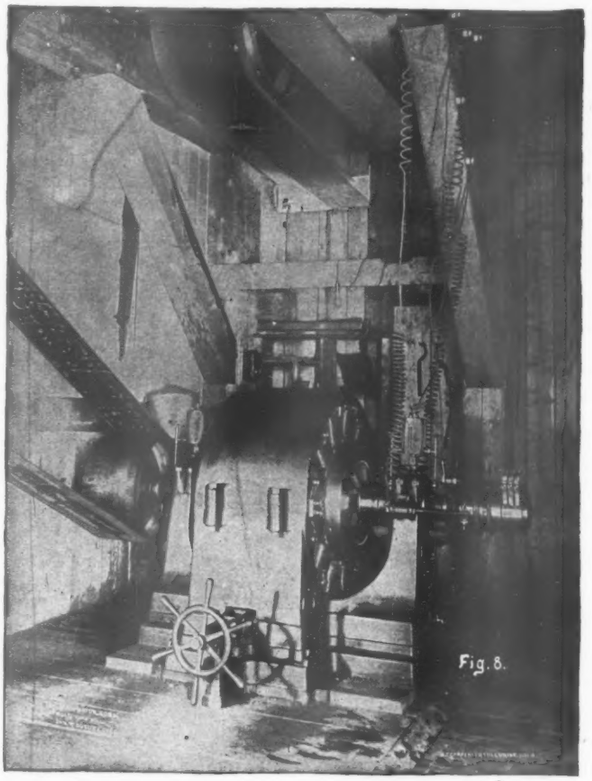
The Stanley single phase alternating current motor, a diagram of which is presented, has been brought before the public during the year. In this system there is placed in series relation to the field-magnet circuit a condenser which prevents the lag of phase in the polarizing current for the field-magnet, and, it is claimed, largely increases the power and efficiency of the motor. In some cases the condenser may be placed in series with both the armature and the field-magnet. A somewhat analogous construction to this was brought out by Elihu Thomson during the year, which is illustrated in a diagram. In this case the peculiarity of a condenser in causing a lead of phase in an alternating current is also utilized. A number of shifting poles are produced in the motor by two independent circuits, one of which is lagged by self-induction, and in the other of which the lag is overcome by the use of condensers placed in shunt relation to the coils. The conjoint action of the two circuits causes a progression of the magnetic poles which drags around a rotary element, which may be a simple block of iron or a structure of laminated plates surrounded by a shell of copper, or wound with a closed coil. The commercial introduction of the new Stanley alternating current transformer, an engraving of which is presented, has recently commenced. This transformer, it is claimed, has an efficiency of 93 to 97½ per cent. at full load, 90 to 97 per cent. at half load, and 85 to 96 per cent. at quarter load. The company promoting these transformers are recognized advocates of large transformers. If the triphase system hereinbefore alluded to should be brought into use in this country for transmission of power over very long distances, it is probable that larger transformers than are commonly used in this country will have to be used. It was demonstrated in the Frankfort experiment that a low frequency of current had to be used for successful transmission, as low as 20 periods per second, although the system was designed for 40. With this low rate of reversal large transformers would be required, a fact which will necessitate either some modification of the Frankfort system, or the use of larger transformers.



AN ELECTRIC LIGHT BATH.



THOMSON'S METHOD OF INCREASING FREQUENCY.



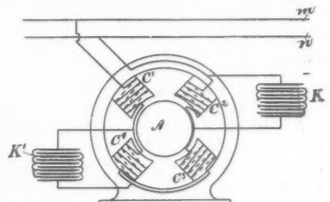
SYNCHRONIZING MOTOR IN TELLURIDE PLANT.

SUBMARINE ELECTRIC LIGHT FOR DIVER'S USE.

MINING APPARATUS.

In mining operations the alternating current has been rendered serviceable. In the Marvin electric drill, of which a diagram is presented, the generator delivers single phase alternating currents, and has one brush connected at a point between two motor coils on the drill, the terminals of the coils returning to the generator through coils wound over two separate magnetic rings, maintained magnetically at the saturation point by a battery or other direct current generator. The coils on the two rings are wound in reverse directions, so that when the alternating current generator is delivering a positive impulse, one ring will be super-saturated, while the other will be cut down in magnetic strength. By reason of the choking action exerted by the latter ring, the bulk of the current will flow through the former; at the next reversal conditions will be reversed, and in this way the two coils operating the drill successively receive current, which reciprocates the tool.

Another operator who did considerable in the mining and drill industries was

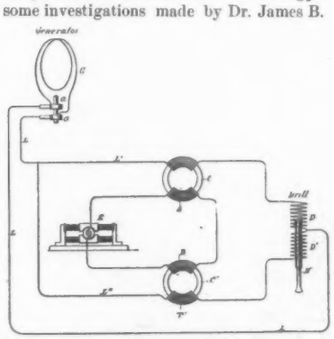


THOMSON'S ALTERNATING MOTOR.

Charles J. Van Depoele, whose death occurred during the year. Mr. Van Depoele was actively engaged in inventive work in the electrical art for a long period.

OIL INSULATION.

Much has been said and written during the year about oil insulation. According to some investigations made by Dr. James B. Williams, in the latter part of the year, it would seem that oil is not such an efficient insulator as was generally supposed, it being shown that a simple jute filling supporting a wire in a pipe would be more efficient if used without any other filling in



MARVIN ELECTRIC DRILL.

its interstices than ordinary air than if it were soaked in oil. Rosin oil, paraffine oil, linseed, cotton seed and castor oils, were experimented with at a voltage of 2,000, the tests all showing that air at a humidity of 80 per cent. is "infinitely superior to oil for insulating conductors carrying such currents." It was concluded that the dirt and moisture liable to impregnate oil used on ordinary insulators largely interfered with their efficiency, the conclusions of the experimenter being that insulators made of glass containing a large proportion of pure silica would yield much better service without than with the presence of oil. This paper was somewhat of a surprise to the profession, because the merits of oil had been blazoned forth from various sources at an earlier portion of the year as exceedingly great, and all sorts of propositions were made by ingenious electricians for utilizing its supposed magnificent insulating properties.

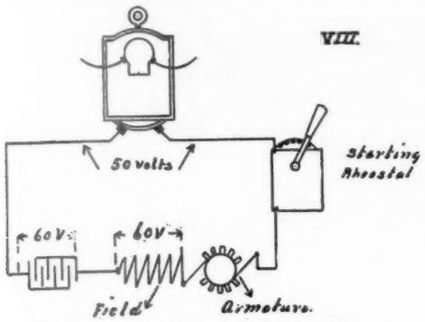
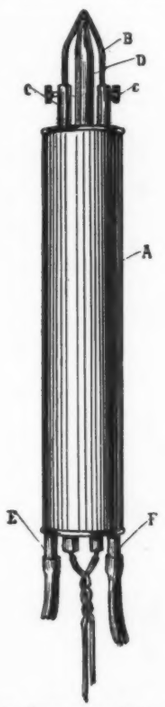


DIAGRAM OF STANLEY ALTERNATING MOTOR.

STEPHEN D. FIELD.

SCIENTIFIC INVESTIGATIONS.

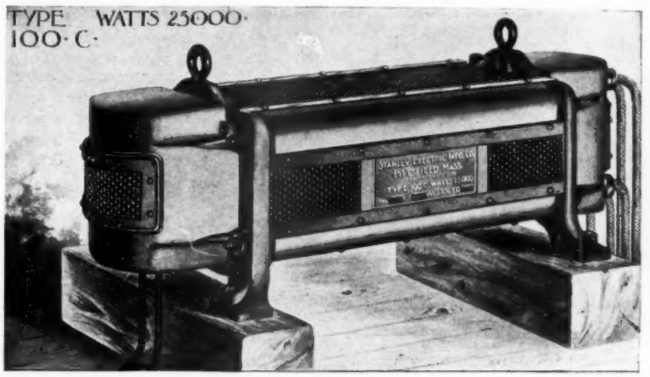
Several interesting scientific results with alternating currents of high frequency, in the same line with those attained by Mr. Tesla something over a year ago, were made by other experimenters. At the Crystal Palace Exhibition a large number of Mr. Tesla's experiments were repeated with a 130 horse-power transformer, the primary of which carried 50 amperes and 2,500 volts, and the secondary two amperes at 52,000 volts, with a frequency of 66 per second. A plate of glass 2½ millimetres thick was pierced in less than a minute. An enormous arc, varying from a foot to two feet in length, was produced. A water tank was arranged above a tray so that the water would drip in the line of the current, the latter passing through the drip illuminated it as it fell and heated it to a temperature such as would reduce it to steam before it reached the tray. Two circular wires, one within the other, connected with the terminals of the machine, showed nodes on the wires as bright spots with great distinctness, these nodes appearing at 20,000 volts and becoming brighter up to 50,000. The characteristic feature of these results was that they were attained with currents of high tension but of low frequency, wherein they differed from the experiments of Mr. Tesla. At a recent date similar results have been attained by Dr. Schoentjes, in which many of the results, for which high tension and high frequency was thought necessary, have been attained with a simple vibrator, battery and induction coil, such as are easily accessible to any amateur, many of the results being repeated with a rate of vibration as low as five beats per second. With this simple apparatus, with both secondary terminals open, a Geissler tube could be made to glow if held in the hand of the experimenter 10 inches from the coil. Leaving one of the secondary terminals open and connecting the other to a sheet of iron supported from the ceiling by a non-conductor, if the open terminal is connected to a vacuum bulb provided with a straight filament, the latter will glow. A Crookes tube held below the sheet of iron will glow. The two terminals of the secondary connected to a conductor having a spark gap makes a vacuum tube glow within the gap. These results are highly interesting and capable of repetition by a simple outfit accessible to any experimenter.



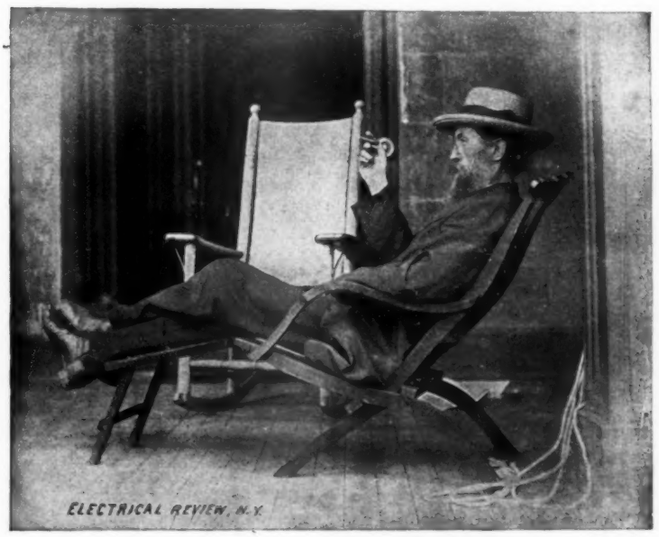
GLASS ENGRAVING TOOL.

THE STORAGE BATTERY.

An important storage battery decision was rendered by the United States Circuit Court of Appeals in October. The protracted litigation in storage batteries has interfered materially with the commercial development of these devices in this country, and, as a result, they have a much smaller range of application than in other countries. The decision now referred to, however, sustained the broad claims in Brush's patents to an electrode consisting of a support coated with any mechanically applied active material. As this covers all forms of storage batteries, except those based upon the Planté idea, wherein the active material is not separately applied, but is developed by repeated charges and discharges of an ordinary lead plate, it is probable that the subject will now have a commercial stability which will permit of a more extensive use.

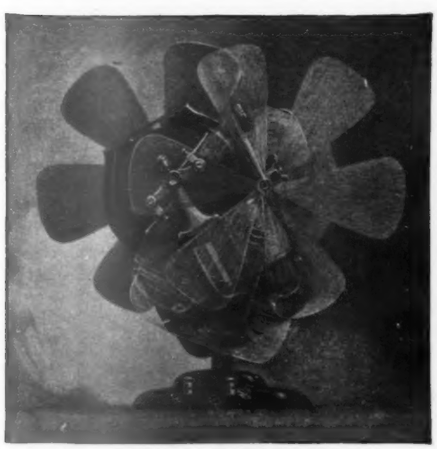


STANLEY TRANSFORMER.

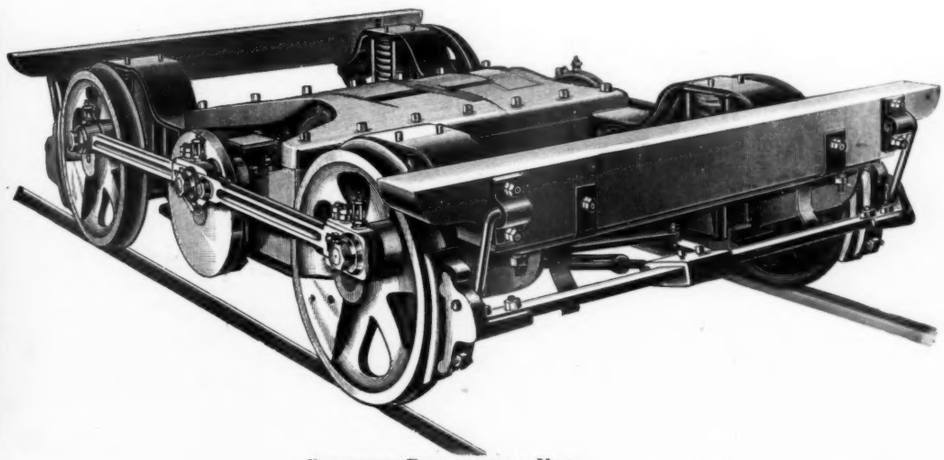


RUDOLF EICKEMEYER.

Mining locomotives and coal-cutting machinery have steadily progressed during the year. A noteworthy example is a recent mining locomotive of the General Electric



CROCKER-WHEELER FAN MOTOR.



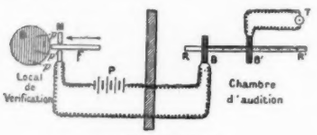
EICKEMEYER-FIELD RAILWAY MOTOR.

Company, arranged with a special view to operation in low and narrow entries.

In small direct current motors a number of novelties have been introduced during the year

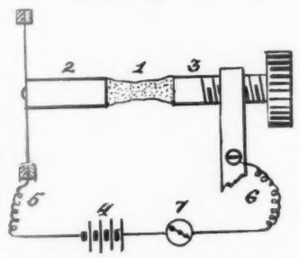
ELECTRIC RAILWAYS.

Electric railways have had a phenomenal growth during the year, a result which might well be expected from the excellent



SCHISKOPHONE.

service which they have rendered in the past five years, and the cheapness with which they may be operated, and the efficient service which they render. As a mode of rapid transit, it is probable that this mode of locomotion will, in the near future, outrival all other systems. The trolley system is still, practically, the only system in use, a result accounted for by the fact that it is cheaper to install than other systems, the expense of the equipment being, practically, about as cheap as a car system, whereas the earnings exceed all those of horse car systems by about ten cents per car mile, because of the increase of patronage resulting from the satisfaction of the public with the rapid intercommunication afforded. Up to October there were in operation in the United States 469 electric roads, operating about 8,000 motor cars and about 4,000 trail cars, and involving a capital stock of about $206,000,000. Over 30,000 car horses were relieved of duty



CLAMOND'S TELEPHONE TRANSMITTER.

within a single year, and 84 new roads were equipped. The opposition to the trolley is rapidly disappearing, it being founded upon purely aesthetic grounds and fostered by a few sensational newspapers desiring captivating news items. The dangers of operation in the trolley are such as would be incident to any system of rapid transit, and are in no way a result of the electric mode of propulsion. The current used for driving the cars has a higher margin of safety than steam or other modes of propulsion. The alleged disfigurement to the streets is a purely aesthetic objection, and with the modern styles of equipment this really disappears, as the pole lines as now constructed are rather ornamental than otherwise; but, leaving this fact out of consideration, modern municipal requirements demand an efficient mode of rapid transit, and electricity stands ready to offer this.

Storage battery systems and conduit systems have not as yet gone into any considerable degree of practical use, but, with the patent question of the storage battery settled, it is probable that this mode of furnishing current, which offers the supreme advantage of making every car, both as to its source of energy and as to its mode of propulsion, entirely self-contained, will meet with wider adoption. Several storage battery systems are in practical use and are alleged to give perfect satisfaction, and it is probable that this style of locomotion will undergo a larger development in the near future. Not only are the large number of electric railway plants recently installed represented in the smaller cities and towns throughout the country, but even metropolitan towns, such as St. Louis, Baltimore, Minneapolis, St. Paul, Buffalo, Rochester, Boston and Brooklyn, have adopted them. New York and Philadelphia are now about to follow suit. The motors for operating the cars have been going through a process of simplification and perfection peculiar to all electrical apparatus. The double reduction gear system has given way to the single reduction, and the latter is now being replaced in a large number of instances by the gearless motor, in which the armature of the motor is applied directly to the car axle, being supported upon a tubular sleeve surrounding the axle and suitably mounted upon springs to reduce shocks.

Within the past month a new overhead electric railway at the Liverpool docks in England was tested and a speed of over 50 miles an hour attained. It is estimated that this railway will carry an annual traffic of over a million persons, the line extending along the whole length of the docks of Liverpool, a distance of six and one-half miles. A new system started in January in Philadelphia is said to give great satisfaction, and will, perhaps, result in quickening the normally slow pulse of the Quaker City.

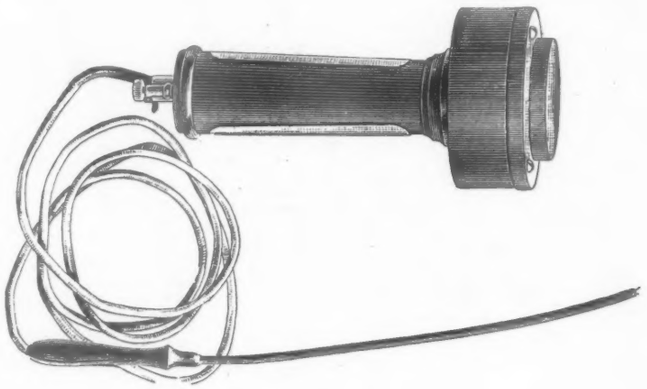
We present an illustration of an Eickemeyer-Field motor for railway use, in which the motor is connected with the car wheels by means of cranks, a system which relieves the motor of shocks. This system is peculiarly serviceable with motors of the Eickemeyer type, in which high counter electromotive forces are generated at low speeds. Portraits of the inventors of this system, Mr. Stephen D. Field and Mr. Rudolf Eickemeyer, are presented for the edification of our readers.

UNDERGROUND RAILWAYS.

Electricity lends itself with peculiar advantage to the operation of underground railways, and since the practical adoption of such a system in London, other cities have followed suit. Such a railway has been in progress in Paris, which is estimated to cost about 54 millions of francs. The length of the line will be 6.1 miles, divided into three branches, one connecting the Place de la Concorde with Bois de Boulogne, having five stations; another connecting the Place de la Concorde with the Place de la Bastille, having seven stations, and another connecting the Place de la Concorde with the Porte de Vincennes, the latter being connected with the other two. The tunnel will be water-tight, formed of water-tight tubes about 18 feet in diameter. The tunnel will be lighted with incandescent lamps, and the stations with arc lights. The power station will also be underground, and partially supplied by water from a canal. Another underground road is authorized for London, which will cost about $6,000,000. Berlin is also to have one, two circular tunnels, with diametrical lines running north and south and east and west, being provided. The cost of this plant is estimated to be about $3,000,000. Steel, oval-shaped tubes 11½ feet high and 10 feet wide, constructed on the Greathead system of driving, will be placed about 25 feet below the street.

LONG DISTANCE TELEPHONY.

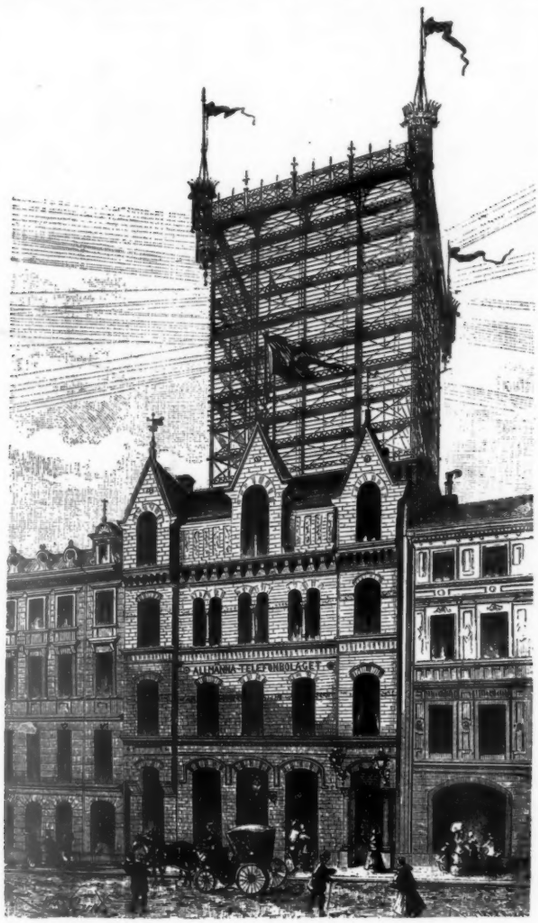
The past year has been full of interesting telephone matters. An event of great importance was signalized in October by the opening for commercial business of the telephone line between New York and Chicago. The service rendered is excellent, the line being almost entirely an air line, cables being avoided as much as possible, by reason of their damaging effect on the clearness of conversation. The cable lengths are restricted to short distances at the terminal stations. The circuit is a complete metallic circuit of No. 8 copper wire, weighing 435 pounds to the mile. The entire length of cable is less than five-eighths of a mile, being approximately the same length in both cities. The charges for a five minutes' conversation are $9, and it is said a liberal amount of business has already been transacted on this basis. All the patrons are well pleased, the conversation being exceedingly clear. It is believed by increasing the size of the conductors the limit of telephonic



TELEPHONE PROBE.

PROFESSOR BELL TALKING TO CHICAGO AT THE OPENING OF THE NEW YORK CHICAGO TELEPHONE LINE, OCTOBER 18, 1892.

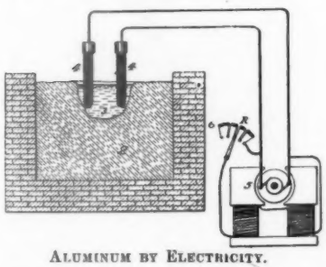
intercommunication may be largely increased; indeed, during the last few months this line has been extended to Boston, and telephonic communication between Boston and Chicago is now in commercial operation. We present an interesting cut, showing a scene at the New York end of the New York and Chicago line at its opening in October, where Professor Bell is seated at the telephone and is conversing with Mr. Hubbard at the Chicago end, the latter having been one of the pioneers in the telephone, and interested with Professor Bell at the Philadelphia Centennial when the telephone was first exhibited there in 1876. The conversation is an interesting and earnest one, as the two gentlemen had not met since 1876. We presented last week a similar view at the Chicago terminal of the line during its opening between Boston and Chicago, which occurred on February 7, 1893, where Mr. DeWolf Hopper is delighting the Bostonians with a song and story, and one at Boston with Governor Russell speaking.



STOCKHOLM TELEPHONE BUILDING, SHOWING WIRE TOWER.

We present, also, a view of the telephone building at Stockholm, Sweden, an interesting report of which graced the columns of the REVIEW during the year.

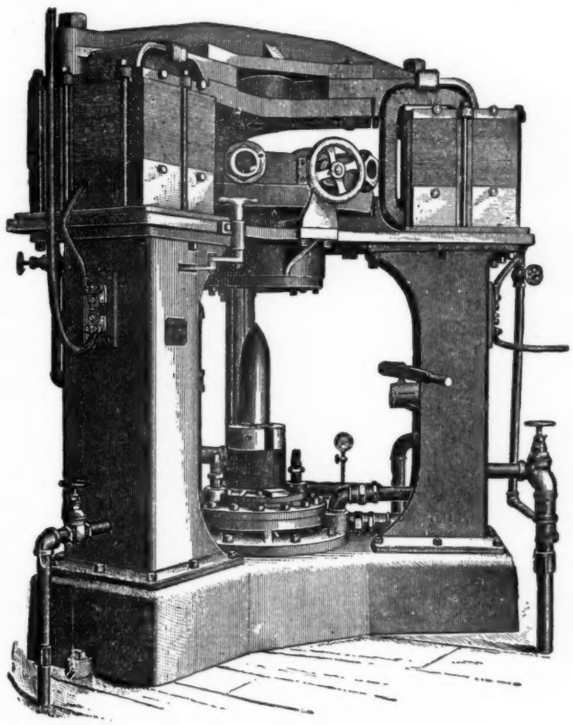
Telephony, as is well known, has an interesting application in surgical operations. Elsewhere is shown a modern telephone probe, which is entirely self-contained, no battery being necessary for its operation. To the handle are fixed copper and zinc plates, shown by the engraving, these plates being connected with the magnet coil. The moisture of the hand supplies the necessary electrolyte, and the current is led to the probe with which the surgical exploration is made.



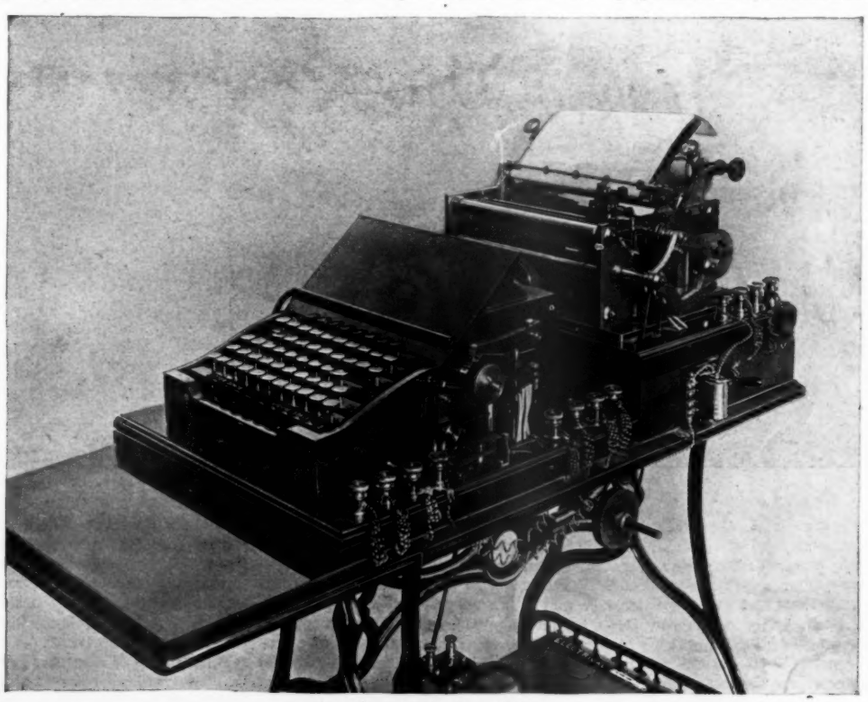
ALUMINUM BY ELECTRICITY.

EXPIRATION OF THE BELL PATENT.

In view of the near termination of the basic Bell telephone patent, inventors are scheming to design a suitable transmitting instrument which will be free from conflict with the microphone patents. Clamond's as instrument is diagrammatically illustrated, in which a plastic button is used between two conducting terminals, one of which is fastened to a diaphragm. It is claimed that this plastic button, which is formed of a paste made by mixing conducting powders with syrupy liquids, acts like a liquid transmitter, the path of the current being elongated and shortened by the action of the diaphragm. In view of the Berliner patent and the broad Edison telephone patent issued last May, in which claims were granted covering a microphone provided with two contacts of an inferior conductor, one of which is connected to the diaphragm, instruments of the Clamond character may shortly make important and interesting history. We must mention Mercadier's bi-telephone, the most prominent feature of which is its applicability to the ear, because it is of such lightness and size that it may be inserted within the ear, thus dispensing with the use of the hands in supporting the instrument. This bi-telephone, although it has an exceedingly small diaphragm and weighs one-eighth as much as the ordinary telephone, is said to have remarkable clearness of articulation, produced by employing a diaphragm whose fundamental is below the mean pitch of the human voice. It has been used for a year in a Paris exchange, and is said to have given satisfaction.



MACHINE FOR ELECTRICALLY WELDING PROJECTILES.



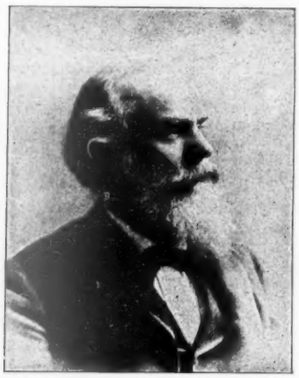
AMERICAN TYPE TELEGRAPH.

ELECTRIC WELDING AND HEATING.

The art of electric welding, although now several years old, has been steadily growing during the year. An engraving is presented of an electric welding machine for large projectiles, in use by the American Projectile Company, of Lynn, Mass. The welding operation is conducted rapidly and efficiently by a heavy current of electricity passed through the shell at the weld. Steels abso-

lutely unweldable by any other process may be by this integrally joined together. The heat can be checked at any moment by the simple use of a lever and easily regulated.

Electric heating has now arrived at the stage where it is being employed for commercial duty. Several illustrative cuts were presented in a late number of the ELECTRICAL REVIEW, showing electric heaters of various designs now on the market, and intended to warm apartments, as well as a full line of culinary utensils designed for use in the kitchen. While the use of the current, when the heater is in operation, is an expensive indulgence, it must be remembered that the cleanliness and ease of manipulation of the electrical devices, and the short period of service needed



EXAMINER GEORGE D. SEELY, ELECTRIC POWER, ETC., U. S. PATENT OFFICE.

for cooking, places them on a plane of expense which will render cooking by electric heating a competitor of other modes now in use. Until comparatively lately cooking by electricity was rather a scientific novelty, and confined to special occasions where elaborate bills of fare were rendered especially attractive by the announcement of the fact that the articles were all prepared by the use of electric heat. The fact that two quarts of water may be raised to a boiling point by the expenditure of four amperes of current at 110 volts in 10 minutes, at an expense, under the existing rates of charges for current, of 1½ cents; that chops may be prepared with seven amperes in 10 minutes, at an expense of two cents; that beef may be roasted at a proportional rate; and so on, brings cooking by electricity to a status in which the ordinary layman can consider it as a mere matter of dollars and cents, and where it will probably thrive in spite of the assurances of wiseacres, who remind us that this branch of electricity can have no considerable field of application, because of the enormous losses in energy between the fire box at the central station and the heating device of the consumer. The losses are compensated for, in a large measure, by additional convenience, quickness of result, short period of service, cleanliness, and the many offsets which accompany other modes, as, for example, in the use of a coal range with its accompaniments of dirt and chimney wastes.

TELEGRAPHY AND MISCELLANEOUS PROGRESS.

In telegraphy the distinctively new apparatus which has come into service is not very extensive. We mention the Cuttriss carbon relay, an ingenious instrument designed for submarine cables, where a change of resistance is used in the relay circuit, instead of an abrupt break, and a differential system is employed for magnifying this change. We present an engraving of the American type-telegraph, in which the message is delivered in the form of a printed page eight inches wide. The instrument is automatic in its action, the transmitter being similar to a typewriter.

In battery zincs an improvement of considerable interest was made by D'Infreville, a well known telegraph inventor, in which the zinc is provided with a hollow conical projection, so that any number of zincs may be coupled together by the entrance of one cone into the hollow portion of another one. In this way, when the zinc is partially consumed, its conical top may be inserted in the hollow of a fresh zinc and the use be continued, all the zinc being rendered serviceable.

An interesting invention is a sculptors' tool, operated by an electric motor reciprocating the tool, and enabling the sculptor to rapidly and accurately perform his work.

An engraving is presented of a tool used for engraving on glass, in which two conductors are brought close together and connected with a piece of platinum wire. The wire is heated to incandescence, and, by causing a sudden expansion of the glass to which it is applied, causes the latter to chip in lines following the movement of the tool. The body of the tool is kept cool by water, and is provided with a slate tip to further prevent heat in the handle.

An interesting device is the electric schisophone. As illustrated in the engraving, the instrument is intended to detect flaws or cracks in pieces of metal. The object to be tested is struck three times per second by a hardened steel rod which passes through a microphone, and the sounds are communicated to a telephone receiver in a distant chamber. If the object being tested is perfect, the sound remains the same as the instrument is passing over its surface; the slightest flaw or inequality of the metal is indicated by a sudden change in the volume of the sound in the receiver.

The influence of electricity in metallurgy has been notable especially in the manufacture of aluminum. In a patent issued during the year, which has been undergoing the vicissitudes of the patent office since 1883, is described a simple method of fusing the ore by first springing an arc, which melts the ore and renders it a conductor, the current then electrolytically decomposing the ore and throwing down pure aluminum metal. An engraving of the apparatus is presented.

A simple improvement in battery jars has been made, designed for special service with gravity batteries. It is intended to prevent the displacement of the solutions produced by shifting the copper or zinc electrodes. The conductor leading from the copper is carried through a hole punched near the top of the glass jar and given a twist which securely locks it, and enables the terminals to be handled without displacing the electrodes.

CROWDED CONDITION OF EXAMINER SEELY'S ROOM, U. S. PATENT OFFICE.

Several engravings are presented which show the prime need of better facilities for the transaction of business in the United States patent office. The subject was very exhaustively treated in the ELECTRICAL REVIEW. The engravings show the two electrical divisions, in which our readers are especially interested. By reason of inadequacy of room in the two branches of the electrical department, which are in charge of Principal Examiners Geo. D. Seely and Gustav Bissing, it is impossible to accommodate a sufficient force to handle the work expeditiously, the patent office building being largely occupied by other departments of the government, which have no business there and which prevent the best fulfillment of the service intended to be rendered inventors when the building was erected. Inventors are obliged to wait from four to six months for a consideration of their applications, solely because of the neglect of the government to furnish adequate facilities for the prompt transaction of business.

CROWDED CONDITION OF EXAMINER BISSING'S ROOM, U. S. PATENT OFFICE.

EXAMINER GUSTAV BISSING, ELECTRIC LIGHT, TELEGRAPH AND TELEPHONE, U. S. PATENT OFFICE.

A portrait is presented of Cyrus W. Field, whose death occurred July 12, and whose pioneer service in the laying of the Atlantic cable is matter of familiar history.

Dr. Werner von Siemens, who has been intimately identified with electrical progress

for half a century, was another of the eminent electrical men to depart this life during the year. Other prominent men who died within the year were Dr. Norvin Green, president of the Western Union Telegraph Company, and M. Van Rysselberghe, of Brussels.

Electricity Disguised as Hypnotism in the Dime Museum.

As soon as anything mysterious crops out in the public midst it is bound at some time or other to be connected with electricity. Here is the way in which Mr. Bob Kreamer, in his versatile and breezy dime-museum manner, describes the relationship between the two sciences.

"I tell ye how it was," said Bob Kreamer. "Ye know I'm an electrician, an' hypnotism's in my line. Of course, that's all it is, ye know—electricity. Well, it's a soul-absorbing study, an' I took lessons of Professor Johnson. Ye know Johnson. He's in a dime museum. Well, I've been studying with Johnson, an' this fellow Esmond is one of Johnson's subjects. He's an easy one, an' I asked Johnson to lend him to me, so as I could make experiments myself. Well, I give him the treatment. He was settin' in a chair, an' I pressed the proper nerve centers, an' run my hand down over his face, quick-like, like the Professor said. But I couldn't do anything for two or three trials. On the fourth trial I got him, an' his head fell back. Ye see, my power was too much that time, an' I had him gone too far.

"Well, I made a grab for his ears, an' snapped my fingers, but it was no go. Why for his ears? Why, right back of them, ye see, is the nerve center. Ye press in right back of the ears, low down, an' ye catch the nerves, all of 'em. Well, t' get back t' the story; I was scared. I stuck pins an' needles into him, but he didn't show a sign. Then I pulled up his eyelids like the Professor, an' blew in his eyes. No go. It went on for about 10 minutes an' his hands began to get cold. Then I was scared, an' I hustled a fellow out after a doctor. The doctor came an' said it was hysteria, an' he pressed down on the breast bone. That wasn't any go, an' I telephoned for the Professor, which he told me to do if I got in any trouble. The fellow was gittin' worse an' worse all the time, an' I was scared. But, then, I don't see any use of making any fuss about it. He's all right now."

"Well, what did the Professor do?"

"What did he do? Why, he just ketched him behind the ears an' give 'em a snap, an' then he catched him by the eyelids an' blowed his breath in 'em, just like he told me to do, an' then he ketched him by the coat an' give him a shake, an' said. 'Here, you, wake up!' an' he woke up."

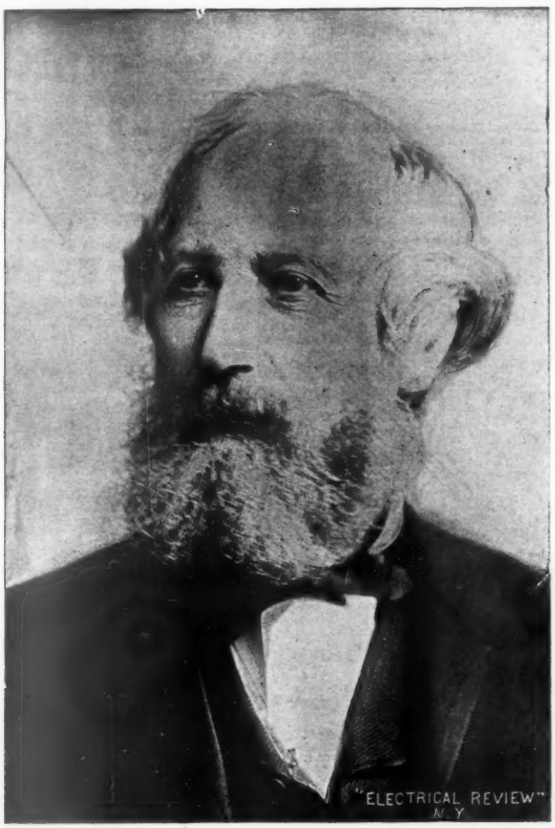
"Was that all?"

"Well, Esmond says. 'Where am I?' Ye see, he wasn't damaged any, an' that's all there is to tell. Hypnotism, I tell ye, is a soul-absorbing study."

Great Britain and France and the World's Fair.

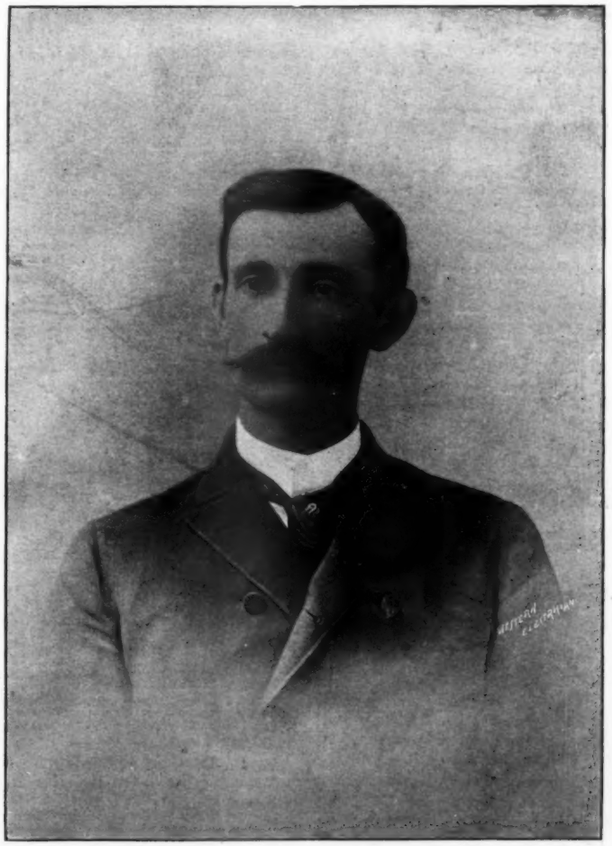
The French colonial section will probably be one of the most popular at Chicago, and is sure to be exceedingly picturesque. The Algerian and Tunisian exhibits will be displayed in part in the Agricultural Building and in part on the lake near the Live Stock Buildings. Two original and very pretty structures will be erected there by the well-known French architect, M. Maurice Yvon, son of the well-known painter of that name. The first of these will be a Moresque pavilion covering a surface of over 400 square yards. The central *patio* will be surrounded by porticoes in the form of Tunisian arcades. These porticoes and the *patio* itself will be used for the display of exhibits. On either side of this pavilion will be constructed *souks*, sheds open to the view, where native artisans can be seen at work making Moresque jewelry, pipes, slippers, etc., which will then be placed on sale. The whole pavilion will be surrounded by a sort of pent house covered with green tiles, and will be a faithful copy of that striking Moresque style of architecture, so rich and original, of which such fine specimens are to be found in the African possessions of France. In this pavilion will be grouped the products of Algeria and Tunis, such as cork, olive oil, figs, dates, almonds, and particularly wines. "The Algerian and Tunisian wines," writes Mr. Henrique, who has charge of the Colonial exhibit, "already enjoy a high reputation; but it is believed that the day is not far distant when they will become a still more formidable rival of the wines of Southern Europe." Among the African vineyards that will be represented at Chicago not a few, it is curious to note, are owned by Arabs; for, notwithstanding the Prophet's formal prohibition concerning wine, the number of Mohammedan wine-growers is increasing every year.

The total space occupied by Great Britain and the Colonies at Chicago will in all probability be more than 500,000 square feet, exceeding the amount occupied in Paris in 1878, viz., 360,000 square feet, the largest space ever before filled by the British Section at any exhibition. In Vienna 170,000 square feet were occupied, at Philadelphia 195,000, at Paris, in 1889, 233,000. At Paris in 1889, Belgium occupied 120,000, the United States 113,000 square feet. No other country had more than 65,000. Of the total area allotted to Great Britain and the Colonies at the Chicago Exhibition it is [illegible] representative and most reliable concerns in the southwest is that known as the Fidelity Carbon Manufacturing Company, whose office and factory in St. Louis are situated at 2134 to 2140 De Kalb street. This company was incorporated six years ago under the laws of Missouri with a paid-up capital of $25,000, and its trade now extends throughout the entire United States. Mr. S. G. Booker, the secretary and manager, is dent and self-governing, lend, on such an occasion as the present, so much strength to the Empire, and enable it to hold a position that without such aid it could never pretend to occupy. This is an advantage which no other country possesses, and one of which we Britons may surely with some justice be proud. It is not very easy to ascertain accurately the way in which space was devided between the mother country and the Colonies in previous exhibitions. At Paris in 1889 the Colonies and India only took up 38,000 square feet of the total area of 230,000. At Philadelphia the proportion was very much larger, and the Colonies seem to have occupied more than a third of the whole space.—*From the North American Review for February.*



CYRUS WEST FIELD.—DIED JULY 12, 1892.

CHARLES J. VAN DEPOELE.



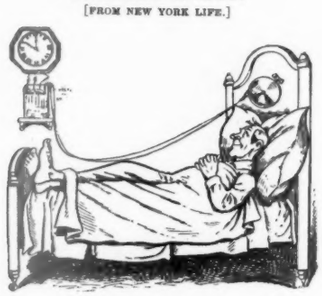
MARMADUKE M. M. SLATTERY.—DIED DECEMBER 15, 1892.

ATTEMPTS AT HUMOR BY OUTSIDE BARBARIANS.

Electric heating has now arrived at the stage where it is being employed for commercial duty. Several illustrative cuts were presented in a late number of the ELECTRICAL REVIEW, showing electric heaters of various designs now on the market, and intended to warm apartments, as well as a full line of culinary utensils designed for use in the kitchen. While the use of the current, when the heater is in operation, is an expensive indulgence, it must be remembered that the cleanliness and ease of manipulation of the electrical devices, and the short period of service needed

CROSSED WIRES.

[FROM NEW YORK LIFE.]

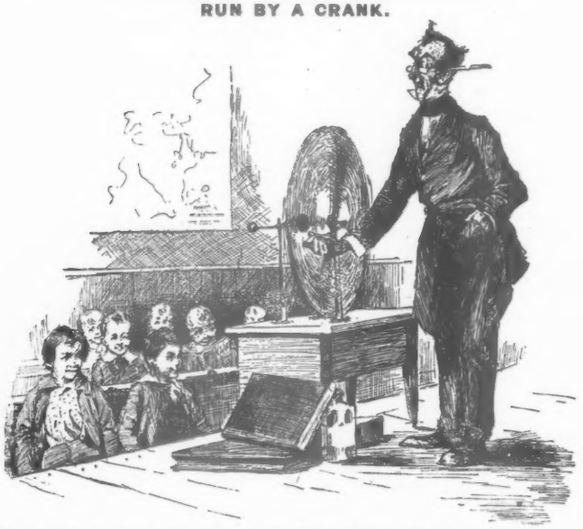


Professor Volt, the electrician, has perfected an ingenious device to supplant the old-fashioned alarm clock. He knows he will be awakened at six.

Being a restless sleeper, his feet become entangled in the wires.

But he was awakened at six.

RUN BY A CRANK.



PROFESSOR (to class in physics): Now, describe this electrical machine, if you please.
HEAD BOY: It consists of a large glass wheel, turned by a crank. (Applause from the class.)—*Brooklyn Life.*

AFRAID TO INHALE IT.

DOCTOR—"Why, are you going to leave simply because you have to talk through the te'ephone?"
BRIDGET—"Av coorse Oi am. Oi don't want t' be inhalin' th' breath av thim different people all th' toime, begob!"—*Judge.*

A DIFFERENT CURRENT.

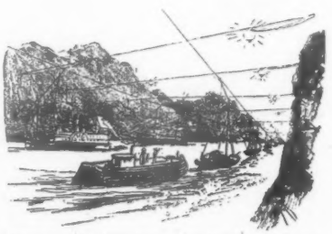
"Well, I've heard of red currants, black currants and white currants, but I'll stop chewin' if ever I heerd of alternating currents.—*New York Truth.*

Bent the Lightning.

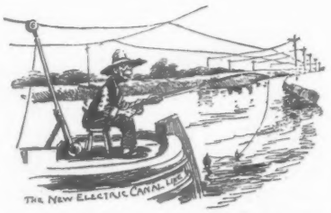
"I was going to bed the other night at my hotel at Sea Beach when a streak of lightning came in through the window and struck my mattress."

"What was the effect?"

"Bent the lightning double."—*Brooklyn Life.*



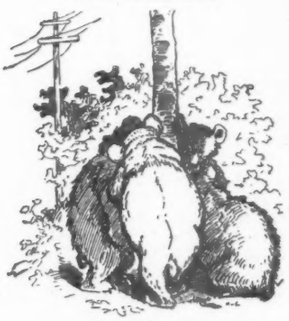
What the Hudson River May Come to.—*Once a Week.*



NEIGHBOR (on bank)—"What are you fishing for, Pat?"
PAT—"It'll be fur electric eels!"—*Once a Week.*

BEARS HUNTING BUSY BEES A BOLT OF LIGHTNING FIND.

[FROM BROOKLYN LIFE.]



"It's Bees."

"The Honey is at the Top."

"Ha, Ha! We'll Get it Yet."

They Get It.

Of Course, It Would.

"Telephone girls in Chicago look black over an order to dress in uniform of that sable color," said the Judge.

"No wonder they object to black. Yeller would be more appropriate for a telephone girl's uniform," replied the Major.—*Pittsburgh Chronicle-Telegraph.*

The Shultz Belting Company, St. Louis.

The business of the Shultz Belting Company was begun by Mr. J. A. J. Shultz about 16 years ago. He introduced improved methods of manufacture, including surface tanning of leather, leaving the interior clear rawhide, insuring to the belt the necessary elasticity, coupled with remarkable strength and durability. Repeated enlargements of manufacturing facilities were necessitated, and in 1877 the business was incorporated under the existing style of the "Shultz Belting Company," with a paid-up capital of $300,000, Mr. J. A. J. Shultz,

Mr. J. A. J. Shultz, President Shultz Belting Company, St. Louis.

becoming president; Mr. Wm. P. Mullen, vice-president; and Mr. B. C. Alvord, secretary and treasurer. The works at Bismarck and Barton streets were especially planned by Mr. Shultz for the purpose, and comprise one, two, three and four story buildings, covering an area of 200x166 feet in dimensions. The equipment of machinery and appliances is the most perfect of the kind in existence. The officers have a special tannery on the premises, where they select all their leather with the utmost care, and follow it through all processes with the most rigid inspection. Shultz patent sable rawhide belting has won an international reputation upon its merits, and possesses special characteristics nowhere else duplicated. The rawhide interior is made soft and pliable by the Shultz patent process, thus combining the previous impossible features of the benefits of tanned leather with the strength of the rawhide. The grain is so soft as to resemble kid, causing it to adhere to the pulley, and with its great strength giving remarkable driving power. It is equally adapted to hard service and rapid motion on small pulleys, and in every form of twist connection. All belting is stretched twice before being put together; and the result of all the above is that the record of Shultz patent sable rawhide belting is an enviable one. Shultz patent rawhide lace leather is equally famous and the sales are enormous. Shultz belting is in demand everywhere, and belts are exported to all parts of the world. The works consume upward of 30,000 hides annually, and the industry, under the able guidance of President Shultz, whose portrait is given herewith, is one of the most prominent and prosperous in St. Louis. Mr. Shultz is treasurer of the Electric Club, of St. Louis, with whose inception he was prominently connected.

The New York offices of the Shultz Belting Company are located at 225 Pearl street, where Manager A. B. Laurence, looks after the large business of the company.

A Course of Lectures for Young Men.

A course of five lectures given under the auspices of the Franklin Electrical Society will be held at the assembly rooms of the Evening Trade School, 225 and 227 East Ninth street. These lectures are delivered every Saturday evening and are on electrical subjects, illustrated by numerous experiments and stereopticon views.

Cooney's Trimmer's Cart.

P. J. Cooney, 900 and 902 Cass avenue, St. Louis, manufactures a neat trimmer's cart. These ingenious vehicles are in successful use as valuable aids to central station managers in Salt Lake City, Trenton, N. J., Erie, Pa., Colorado Springs, Chicago, Louisville, Ky., Memphis, Tenn., Buffalo, N. Y., and St. Louis.

The cart is made for the use of station employés in trimming and cleaning arc lamps. The body is divided into three compartments for carrying globes, tools and carbons of different sizes. Space is also provided for carrying waste with which to clean the lamps. The space for globes is padded and the carbon and tool box may be taken out separately. The cart is supplied with Sarven wheels with steel tires, and the axle is 1½ inches in size, made of the best steel. A forged iron rail extends from the rear of the box to the bottom of the footboard on each side, with a passageway in the center. There is a canvas apron underneath the box which is used as a mudsplasher. The best hickory shafts and singletrees are used. The body is set on the best oil-tempered springs, of Mr. Cooney's own design, connected to the bottom of the axle with brass shackles. On each side there are also Timken springs from the shafts in the rear on the top to the bar on which the box rests. This spring takes all the strain off the bar and spring underneath.

Plant of the Fidelity Carbon Manufacturing Company, St. Louis.

President James I. Ayer, of the National Electric Light Association, has warmly endorsed Cooney's trimmer's carts, and the Municipal Electric Lighting & Power Company, of St. Louis, of which Mr. Ayer is general manager, has adopted a complete equipment of them, which has given eminently satisfactory service, under exceptionally difficult conditions.

ELECTRIC RAILWAY AND POWER NOTES.

It is stated by a local journal that a man from Ashland, Wis., has invented a storage battery of such merit that a joint stock company has been organized to manufacture it.

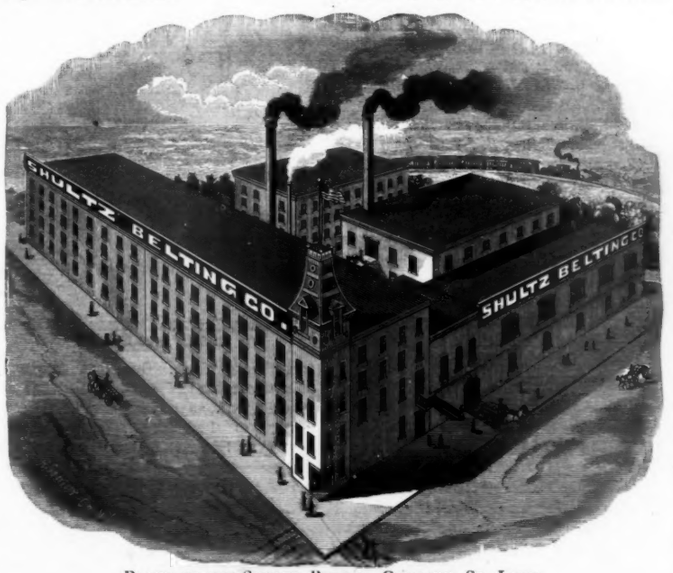
The East Cleveland, Ohio, Railroad Company will shortly increase their motor capacity 1,000 horse-power. During the last cold snap the power was not sufficient to carry on the traffic and run the snow sweeps.

The new management of the Taunton, Mass., Street Railroad put in a petition to the city government last week for permission to erect poles, trolley wires, etc., and run cars by electricity on the present line and all extensions.

The General Electric Company, of Lynn, reports the sale of one-fifth as many railway motors in one week in January as during the whole year of 1892. It is anticipated that the works in Lynn will be very busy during the coming spring and summer.

The good old quiet city of Philadelphia is getting a little something now and then when it gives a franchise to a corporation. In chartering an electric line it has compelled the company, among other things, to agree to pave and light the streets it uses.

A bill has been introduced in the Connecticut legislature which provides that the Governor, with the consent of the Senate, shall appoint three persons, a lawyer, an electrical engineer and a practical business man, to constitute a "board of street railway commissioners," whose chairman shall be designated by the Govenor. It is desired that this new commission shall exercise control over street railroads similar to that now exercised over steam railroads by the board of railroad commissioners.



Plant of the Shultz Belting Company, St. Louis.

Chicago Edison Company.

At a meeting of the stockholders of the Chicago Edison Company, held in the company's offices in The Rookery on February 14, it was voted to increase the capital stock of the company to $3,000,000, to be issued at par to stockholders in such amounts and at such times as the directors may decide.

Nothing was said about the purchase of the Chicago Arc Light and Power Company by the Chicago Edison Company, although the deal is practically consummated, and the Edison Company's debentures are expected to be issued between March 1 and March 15.

The meeting adjourned to meet again at 12 o'clock on March 14. Mr. Samuel Insull, president of the Chicago Edison Company, left Chicago for New York on February 14.

Western Electrical Supply Company, St. Louis.

This company is one of the few electrical supply houses in St. Louis, and a very complete stock is always carried. The company accepts orders for anything electrical, and has agencies for a number of good specialties. They are the manufacturers of the "Regent" rubber covered wire, which has an extensive sale in the West. The officers of the company are Charles Scudder, president; H. K. Gilman, vice-president and treasurer, and R. V. Scudder, secretary and general manager. This company handles the Sun arc lamps and the Detroit motors and dynamos.

Fidelity Carbon Manufacturing Company, St. Louis.

In the manufacture of electric light carbons and carbon specialties, one of the representative and most reliable concerns in the southwest is that known as the Fidelity Carbon Manufacturing Company, whose office and factory in St. Louis are situated at 2134 to 2140 De Kalb street. This company was incorporated six years ago under the laws of Missouri with a paid-up capital of $25,000, and its trade now extends throughout the entire United States. Mr. S. G. Booker, the secretary and manager, is

Mr. S. G. Booker, General Manager Fidelity Carbon Manufacturing Company, St. Louis.

an expert in the manufacture of carbons, and possesses a thorough knowledge of every detail of this important industry. The premises occupied are spacious, and the manufacturing departments are fully supplied with the latest improved appliances, apparatus and machinery, operated by a 120 horse-power steam engine. Here 75 skilled hands are employed, who turn out in large quantities electric light carbons, carbon brushes for electric railway motors, carbons for batteries and all kinds of carbon specialties. The trade-mark of Black Diamond is the best guarantee for the superiority and general excellence of the goods. The Fidelity Carbon Manufacturing Company claims, with justness and pride, to make the best, most durable and uniform carbon in America. Their battery and laboratory carbons are used largely in prominent laboratories and by our most eminent scientists and experimenters, with whom they are great favorites. The capacity of the factory is 50,000 electric light carbons daily, and likewise large quantities of their carbon specialties. Mr. Booker is widely known in trade circles for his ability and integrity, and under his energetic guidance the prospects of the Fidelity Carbon Manufacturing Company are of the most favorable character. Orders are carefully filled at the lowest possible prices, while all goods are fully warranted.

N. E. L. A. Badges at the St. Louis Meeting.

Secretary George F. Porter, of the National Electric Light Association, has made the following announcement regarding the badges to be worn during the St. Louis convention: President, gold button, red bow; officers, association button (sterling silver), red bow; executive committee, same button, blue bow; honorary members, same button, white ribbon; active members, same button, purple ribbon; associate members, same button, violet ribbon; reception committee, same button, yellow ribbon; guests, olive ribbon.

Electrical Supply Company Changes its Name.

Notice was filed in the secretary of state's office of Connecticut that the petition of the Electrical Supply Company of Ansonia to change its name to the Ansonia Electric Company had been granted by Judge Prentice, of the Superior Court, sitting in New Haven.

The Place of Electricity in the Modern Office Building.

BY AN OFFICE BUILDING MANAGER.

A modern office building to be fully abreast of the times must be constructed to anticipate, that is, what is standard to-day is out of date to-morrow. There is a certain and constant ratio of progression both in external and internal construction and fitting that must be provided for; to illustrate, from the electrical standpoint—take dynamos as an instance—the best dynamo of to-day will probably be out of date in two or three years time, so rapid is the improvement in this one line. The last 10 or 15 years have shown us entirely new methods in the construction of office buildings, the heavy piers and inside walls being replaced by the skeleton steel and iron interior that rises up story after story without any necessity of an outside wall, causing a humorous individual to remark as he gazed on the threadlike outlines of a half completed sky scraper: "It reminds me of a tramp in having invisible means of support." In the interior of this radically new construction are equally radical improvements, which, as heretofore, the West will point out the way for the East to follow. Our Eastern conservatism prevents us from leading; but that magnificent freedom from tradition that looks only for results in the West is what is doing its part in developing not only the modern office building, but modern business and methods; consequently, while we may look for minor improvements in the office building in the East, yet it is in the West that the so-called "daring innovations" come to pass. Tradition there don't count. "Get there" is everything, and while I read of the Sheridan Electric Power and Office Building, in Denver, I have in mind a building in New York city, just being completed, for light manufacturing purposes, supposed to be built up to the top notch of modern improvement; it is gridironed with steam pipes and gas pipes, with electricity left out. Such construction is called conservative. One might get nearer the truth by calling it want of sense. The extent that electricity will enter into the modern office building may be predicated on the rapid advances it has made in practical application to business needs within the last 10 years. To-day the modern office building is equipped with electric light, electric call boxes for messengers and telegrams, metallic circuit wiring for long distance telephones and there electricity ends for the present. But what of the new building that must anticipate improvements for the next five years at least; wherein shall they make ready for improvement in their electrical appliances and devices; first, as regards wiring, the hodge-podge jobs of wiring that are at present misconducting electricity by means of loops and tricks known only to the elect, and the elect generally consisting of theoretical experts and practical bell hangers. Such wiring must come to an end and such experts, for the good of the electrical business, must be sent to Botany Bay or the uttermost ends of the earth, it matters not which, so long as they are where they can do no damage. The wiring of the Vanderbilt Building, in New York city, is, to my mind, as a layman, done on correct principles. The wiring is all on the outside of the walls where it can be readily gotten at, and each floor is wired and connected with its proper box on that floor, and the floors of the building are then connected through the switch boxes to the dynamo. The good points are that the wiring is simple, easily understood and readily gotten at for repairs or alterations of any kind. The bad point (for an expert) is that it never gives him a job, as any ordinary engineer in charge of a dynamo is fully competent, after a little instruction, to attend to all the details. So well satisfied do the owners of this building seem to be under the plan now in operation that the new 13 or 14 story extension they are now adding to the building will be fitted, I understand, for lighting purposes with electric wiring only—no gas or piping being used. This is, I believe, a new departure; as, owing chiefly to the bad methods of wiring, the electric light has been considered hitherto a "leetle onsartin"—too uncertain, in fact, to depend on solely. There will probably be very few, if any, hydraulic elevators used in future. The electric elevator is here to stay. Yesterday it was a baby, to day it is a good, healthy youth, to-morrow it bids fair to be a John L. Sullivan in the elevator phalanx, knocking out all competitors with ease. The new Postal Telegraph building in New York city will be equipped entirely with electric elevators, as it will be a 14 story structure, and will require six elevators, in constant use; doubtless the Postal Telegraph people were quite certain of a good job before entering into the contract. The writer heard Mr. Sprague declare that he would submit to any tests, by reputable parties, for his electric elevator, provided the tests were severe enough; but he would have no perfunctory tests—they must be of the most rigid and convincing kind, or he, Mr. Sprague, would not permit them, which certainly shows faith and sound business principles on the part of the inventor. The electric elevator, Mr. Sprague's included, has passed beyond the experimental stage; it is doing the work in a number of buildings, and doing it well; no owner or architect can afford to neglect it now. We shall find, ten years from to-day, that the office buildings then constructed will, probably, be heated by electricity. Two of the primal qualities of electricity, namely, light and power, are now being used. The electric fan is now no longer a luxury in an office, it has become a necessity. What further development electrical power may take in a high class office building is, as yet, undetermined. It sometimes now runs the phonograph when the phonograph battery refuses to work. Inventors are working on electric typewriters; thus another probability is added. And, possibly, the wire may give the office boy a lift on some electric copying press. Who knows? In so-called office buildings where light manufacturing is permitted, the flexibility of electrical power has made a change in many ways. It certainly solves the power problem in crowded business districts for manufacturing light articles.

Heating, by electricity, in office buildings is as yet an unknown quantity. It seems bound to come, as certainly as the future in store for the storage battery, which will also, probably, have its uses in office buildings. While no one can say when these new features will come into practical use, it is nevertheless wise for every owner and architect to make preparations, as far as possible, for future developments, particularly in the electrical field, and nowhere, in the writer's judgment, will electricity have so many applications in different ways, as in the modern office building.

Electrical and Mechanical Engineering and Trading Company.

A new concern bearing the above name has recently been established. This company is entering the electrical business making a specialty of contracting for complete equipment of electric light, railway and power systems of the best classes, with offices in the Edison building, 44 Broad street. Mr. J. H. Vail is president, U. T. Fackenthal, vice-president, George F. Sandt, secretary and treasurer.

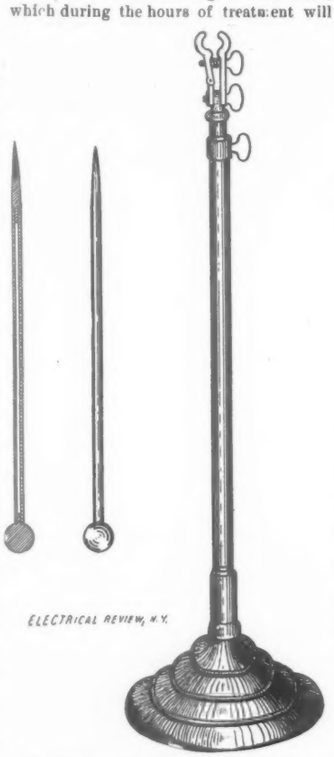
Everyone is familiar with Mr. Vail's work in the past, and this concern under his direction may be expected to be a potent factor in matters of electrical development. Mr. Fackenthal, who is not so well known in this special line, has a large acquaintance in Wall street, and is largely interested in a successful publishing enterprise of this city. "Fack," as he is known to his many friends, is a genial gentleman, and no doubt before many months go by he will have quite an extensive friendship among the electrical brethren. This concern is starting under the most favorable auspices, and the ELECTRICAL REVIEW extends to them its very best wishes for a large success.

A Combination Electrode and Stand for Use in Static Electric Treatment.

BY LUCY HALL-BROWN, M. D.

Static electricity is said to exist or lay only upon the surfaces of conductors, etc., but, as a matter of fact, the spark from a solid brass ball electrode is found to be much superior to that from a hollow brass ball. From a solid ball the spark is compact and full, whereas that from a hollow ball is inclined to be split, producing a stinging sensation quite painful to the patient.

With a static machine, the makers furnish one dozen electrodes of different shapes, and of this number there are rarely used but two—the brass "ball" and the brass "pointer." They consist of a hard rubber handle some 14 inches in length, at one end of which is fixed the brass electrode with a small brass eye into which the snap hook attached to the end of the chain or conductor is to be locked. To change from one electrode to the other, the operator must go through this hooking and unhooking process each time this change is to be made, which during the hours of treatment will



DR. HALL-BROWN'S COMBINATION ELECTRODE AND STAND.

occur many times. Occasions frequently arise where it is desired to localize the spray or the spark, as the case may be, on some portion of the patient specially affected, consequently a device that will support the electrode in any position will relieve and permit the operator to utilize this time to better advantage.

In the illustration is shown a combination ball and pointer electrode, together with an adjustable supporting stand for the same, which stand will also accommodate the various styles of electrodes in use. The combination electrode consists of a piece of half-inch brass tubing, 2½ feet long, at one end of which is fixed a solid brass ball, 1¾ inches in diameter, and a solid brass point at the other end, as shown. In making a treatment, it is simply necessary to grasp the end of the chain and the electrode in one hand, using the other hand to hold the slack of the chain away from the patient.

When holding the bare metal there is not the slightest shock or unpleasant sensation experienced by the operator. It is here presumed that the machinery is being used in the ordinary manner, with one pole connected to the insulated platform, the other pole connected to the gas pipe or other large metallic surface, and the electrode connected by a chain to that surface. The electrode is light and of such length that the operator is enabled to stand at a distance from the insulated platform, thereby avoiding the leakage between the platform and the operator, so usual when using the ordinary short handle instruments, and this is particularly noticeable in cases where the operator is a lady, due to her style of dress. The sparks or the spray can be administered at will by simply turning the ball or point toward the patient.

The supporting stand, which is shown folded, is so constructed that the electrode may be adjusted for any desired direction. It can be raised or lowered, turned to the right or left and pointed up or down. It consists of a round, iron, brass-covered base, 10 inches in diameter, to the center of which is fixed a three-foot length of three quarter inch iron, brass-covered tubing, at the top of which there is a collar carrying a set screw. A second piece of similar tubing and length, but of a smaller diameter, provided at one end with a clamping device, such as is used in retail stores to hold and exhibit umbrellas is made to slide inside the first tube, the set screw retaining it at any height desired. Iron, brass-covered tubing is preferred because it is much stiffer than brass and, therefore, much less liable to get out of shape. The electrode is placed in the clamping device and the end of the conducting chain thrown over it as though both were held in the hand. It might be supposed that such a stand would be an expensive affair, but the one here described cost the writer $5.50, due to the fact that all the parts are to be found in stock at the houses dealing in store fixtures.

Modern Boiler Materials.

"You make the steel and we will make the price." So said a large Eastern boiler manufacturer a couple of years ago, at a convention of the American Boiler Makers' Association, when that organization had fixed upon a certain high standard for steel boiler plates. The steel man had objected to the standard as being unnecessarily high. "We can make the steel all right enough, but you can't afford to pay for it," they said. The sequel is one more illustration of the fact that high quality is not incompatible with reasonable prices for materials, once consumers insist upon having the better articles. The cost of "A. B. M. A." steel is not now excessive. The demand is the button, competition does the rest. It is held by some boiler manufacturers that the "A. B. M. A." specifications for metal are unduly rigid, but, for the most part, the leaders in this line of manufacture are finding that nothing short of "the best" will satisfy the exacting demands of modern well posted steam users. Good engineers want to *know*, and are not satisfied with the builder's "say so," as to the quality of materials used. The practice of the Heine Safety Boiler Company, of St. Louis, in this respect is interesting. In sending orders to the steel mills this company attaches a sheet of specifications (the A. B. M. A. specifications) indicating the physical and chemical characteristics which plates must show under test. When the mills are ready to roll the plates they are instructed to notify the nearest office of a certain well known testing and inspection firm. This concern sends its men to take coupons from the plates as they are rolled. These samples are subjected to careful tests, and all plates which fail to conform to the specifications are rejected. Record is kept of these tests by the Heine Boiler Company, and purchasers who wish to know what they are buying can have access to the original test sheets of the plates used in their boilers.

In these days, when large electric light and power installations are making possible enormous concentrations of power, the tendency of engine practice is decidedly in the direction of compounding and multi-expansion. With the high initial steam pressures resulting from this practice, the quality of boiler materials is a consideration of first importance to the careful engineer, and all efforts like that mentioned above, to raise standards of quality, are to be warmly commended. It is interesting to note, also, how electrical progress has affected modern boiler practice. Centralizing of power in electrical plants has made the efficiency of the machinery used the determining factor in the profit and loss account, or, rather, has emphasized the fact—it is true of small as well as large plants—to such a degree that the central station man who now puts "first cost" of machinery in advance of "cost of operation" is not apt to be a howling success. The concrete illustration in connection with the present topic is the now very general use, in large modern steam plants, of boilers of a good water tube type, even though their first cost may be double that of old style boilers.

Electric Engineering and Supply Company.

AN ENTERPRISING AND SUCCESSFUL ELECTRICAL SUPPLY MANUFACTURING COMPANY.

In the belief that some of the readers of the ELECTRICAL REVIEW will be interested in learning what is being done by the Electric Engineering and Supply Company, of Syracuse, N. Y., we give a brief sketch of this growing enterprise. In 1889 a small supply store and repair shop was started and successfully carried on for about one year, when the idea of manufacturing electrical supplies came to the minds of those interested, with strong convictions, born by evidences so real and potent, that no question was left as to the prosperity of such an enterprise. A stock company was accordingly organized in 1890 with $25,000 capital, a three-story building was leased and equipped with the best of machinery, and the manufacture of electrical supplies was begun. Through the untiring efforts of the company to produce only such articles as would be universally accepted as being the best of their respective kinds, the products gained an enviable reputation, and the demand for them was very large. In less than one year's time their quarters were found to be entirely too small, and in 1891 the large four-story brick factory on West Jefferson street was leased, and is now the most complete plant of its kind, thoroughly equipped with the latest improved machinery in its several departments. Aside from the special switch department and assembling room, there are the laboratory, brass foundry, inspecting room, pattern and wood-working departments, and with these several departments well regulated and superintended, the facilities are unsurpassed for the manufacture of electric lighting and street railway supplies. The entire plant is lighted by electricity from the company's own dynamo especially installed for this purpose. A new boiler house was erected in the spring of 1892, and furnished with two horizontal tubular boilers of 90 horse-power capacity. A new 60 horse-power engine has recently been added, which will require an additional 90 horse-power boiler, for which the company is now negotiating. The capital stock has been largely increased, and it is safe to say that it is now the largest concern in the United States manufacturing a full line of electrical specialties.

Particular attention is given to the quality of porcelain insulation, and this company was the first to use porcelain in the manufacture of sockets, as by its use the insulating parts consist entirely of air spaces and a peculiar quality of porcelain so tough that the brass parts are riveted to it without breaking. The old time rubber key has been supplanted by one made of porcelain. To this and the superior workmanship of all their products, the established popularity of the E. E. & S. sockets, switches, rosettes, main and branch blocks, etc., is due, and the demand for their goods is daily increasing in the markets of England, France, Germany, Mexico, Central and South America and all the British provinces.

In the repair department special care is given to the repairing of all kinds of machinery used in arc and incandescent lighting, rewinding of armatures of any style or type, and a corps of experienced and efficient winders is employed.

Through the ever increasing and almost imperative demands of the company's many patrons and the electrical trade in general, they have created a special department for the manufacture and construction of all kinds of station switches, panel boards, switchboards, arc plug boards, etc. After much experiment they are now producing a satisfactory switch for carrying heavy currents without danger of arcing, made for all capacities from 25 amperes to 1,000 amperes, or more, if required, and designed for breaking currents varying from 50 volts to 1,000 volts, and upwards. They are mounted on polished black or marbleized slate bases, finished to imitate any kind of marble or onyx, or, if preferred, on marble, to suit the taste of the purchaser. The general design is handsome in appearance, and the finish and workmanship on these goods cannot be excelled.

A variety of terminals are supplied to suit the varying conditions, so as to connect the wires by clamping them on the face of the switch, or by soldering them to a terminal, which is afterwards screwed to the switch brasses. The neatest manner of connecting, where conditions will permit, is by the improved concealed terminal, whereby all connections to the switch are made at the back, but so as to form the most intimate and perfect electrical contact. By a simple spring device in the post, closing or opening the switch is rendered easy, and any jar or vibration from accidentally opening or closing prevented. All the switches of this class that were used in the installation of the World's Fair buildings came from this department, together with a number of other articles especially designed by this company. Many exceptionally handsome switchboards are in use all over the country, and wherever they have been installed they have received unqualified praise, by both experts and laymen, for their superior electrical advantages as well as artistic design and elaborate finish. Great care is exercised in procuring slate containing the best dielectric qualities, and the boards are constructed of any size and for any type of arc, incandescent, or power apparatus, and for storage battery work. One of the incandescent switchboards recently built is herewith illustrated.

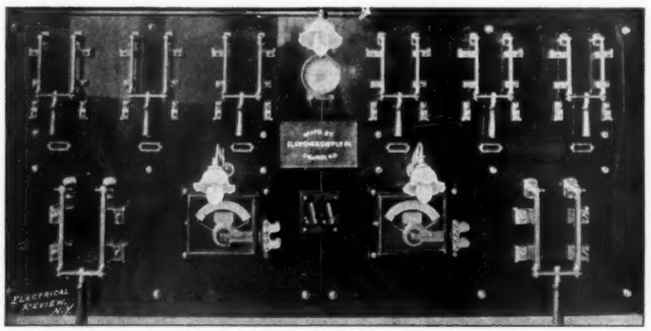


FIG. 1.—INCANDESCENT SWITCHBOARD MANUFACTURED BY THE ELECTRIC ENGINEERING AND SUPPLY COMPANY, SYRACUSE, N. Y.

Besides a full line of key and keyless sockets for any system, double and single pole snap switches, branch and main cut-outs, rosettes, etc., they manufacture many unique specialties for fine installations.

Another specialty which commends wherever a nice installation is to be made is the flush switch, which is let into the wall flush with the woodwork or plaster and finished to match. It is operated either with the ordinary switch key or with a separate key similar to those used with a Yale lock, so that after the switch is turned to the proper position, the key is removed and carried in the pocket of the proper person, making interference with the lighting system impossible.

A handsomely illustrated catalogue has just been issued, containing illustrations of all the articles manufactured, with the exception of a few of their latest productions.

Their main offices are located at 308 and 310 West Jefferson street, Syracuse, N. Y., warehouse at 215 Walton street, with a branch office at 126 Liberty street, New York, of which Mr. F. C. Timpson is manager, agencies at Chicago, St. Paul, St. Louis, Washington, Denver, San Francisco, Victoria, B. C., Montreal, Canada, London, England, and Paris, France. The officers of the company are, H. C. Hodgkins, president; J. L. Hinds, vice-president and superintendent; C. T. Moffett, secretary and treasurer; H. J. Gorke, manager.

FIG. 2.—VIEW IN SPECIAL SWITCH DEPARTMENT, ELECTRIC ENGINEERING AND SUPPLY COMPANY, SYRACUSE, N. Y.

A Novel Sheathing for Vessels.

A London scientist has put forth an idea which consists in sheathing vessels with copper, amalgamating the entire external surface of this metal with mercury, and joining up the same to the negative pole of a galvanic battery or direct current dynamo. The positive pole must be led to earth connection, perfectly in advance of the vessel's bow. The chief advantages claimed are that the exposed surface of the sheathing will be kept exceptionally smooth, bright and clean; that the surface will not afford good hold for the barnacles and other marine growths; that the skin resistance will be much reduced, not only by the smoothness, but also by the electrolytic generation of gas bubbles. It is estimated that the reduced resistance will more than compensate for the cost of maintaining the electric current; and that sufficient gold and silver will be deposited on the sheathing from the water to repay more than the value of the mercury lost.

A New Yorker's Sunday in St. Louis.

BY A PILGRIM.

The beautiful chimes of a church awoke me Sunday morning. I arose quickly, and found the church under the chimes. The sermon was good and well delivered, and the choir singing was excellent. I passed many people in the street and the attendance at the church of the chimes was very good.

After dinner I went to my room in the hotel to read and write. I was rudely disturbed by a most villainous band, which played circus tunes, apparently beneath my window. I went out to discover the why and wherefore, and learned that the band was the property of a music hall and was endeavoring to attract patronage. In spite of the ear-splitting and discordant noise, people went into the concert hall, and many acted as if they were obeying a prearranged signal.

Further inquiry taught me that a Sunday matinee was in progress at nearly every theatre in the city, and that evening performances might be attended, too. More people seemed to be going to the theatres than I had noticed in the morning going to church.

After my theatre inquiries, I took an Olive street cable car and went out to a park. It was very prettily laid out, and in summer is, I fancy, an agreeable place. A gentleman I talked with on the car told me that St. Louis is a great city, although it is, as a rule, unappreciated by strangers. I agreed with him. He said that during 1892 over 34 miles of new buildings had been erected in St. Louis, computed on the front foot, and leaving out of account structures of a less value than $25,000. I was impressed with this man's truthfulness, as I had noticed many buildings which looked new.

During my ride back from the park I saw that St. Louis is seemingly well provided with trolley and cable roads. If a man wants to live in the suburbs in comparative freedom from soot and smoke, he ought to be able to get to his home within a half hour. I was told that a very comfortable suburban residence can be rented for $600 a year.

I overheard two men talking in the cable car. They were discussing the merits of various pugilists, and one man said that the present champion was unbeatable, in fact he was "a hot tamalé." My curiosity was aroused at this, to me, new expression, which, from the connection, I judged was used as a synonym for a "jim dandy," or its equivalent. I asked the hotel clerk about it, and he said I had surmised correctly. He told me to walk down Broadway and I would learn what a "tamalé" (three syllables) was. After walking three blocks I came to a man standing by a large tin bucket which looked like the weinerwurst outfits we see on 14th street, in New York. The man sung out, "Here's yer nice, hot, Mexican tamalés!" I bought one. A tamalé is a little ball of hashed meat done up in what looks like a corn shuck, and steamed in the tin bucket. It is said to be a Mexican delicacy, and has quite a sale in St. Louis.

When I had finished my "supper" at the hotel, the waiter said, "Will you have some canned goods this evening, Colonel?"

"What canned goods?" I answered.

"Green gages and prunes."

"Prunes," said I, thinking to try canned prunes.

"Green gages?" the waiter said.

"No, prunes."

"Will you have some green gages also?" asked he.

"No."

He brought cake and common stewed prunes. I took a lady finger and then another waiter came along, took up the cake basket and said, "Through with the cake, Gov'nor?"

I nodded dissent and he took the cake.

I prepared to retire about nine o'clock, just as the concert hall band again began to toot for custom.

A Visit to the World's Fair.

BY STEPHEN L. COLES.

Many travelers who have visited the great and growing city of Chicago during the past few months have found time to take a run out to the World's Fair buildings, in order to see just what our brethren of the West have accomplished in completing one of the biggest tasks of the age. People in the East, and especially New Yorkers, who are glad that New York didn't secure the Fair, have taken great delight in observing the progress of the work at Chicago, and in making comparisons between what has been done there and how New York would have done the same thing. Chicago has taken advantage of this curiosity of her Eastern friends and foes, and has followed the Western method of utilizing every possible advantage. Although the World's Fair buildings and grounds are still incomplete, nevertheless they are fenced in and the visitor who wishes to inspect the place must pay 25 cents to do it. This has brought a neat sum into the exchequer of the World's Fair management, which will probably be greatly increased before May 1, when the whole show will be thrown open to the world.

During a recent visit to Chicago, I followed the example of many others and made a pilgrimage to the White City by the Lake. I boarded an Illinois Central train at Van Buren street, just opposite the big Auditorium Hotel, and in half an hour was landed at the World's Fair grounds. Doubtless this time will be improved upon during the life of the Fair, and the suburban service of the Illinois Central road will more nearly approach a New Yorker's idea of rapid transit. The first impression gained of the World's Fair grounds and buildings is naturally that of the immensity of the enterprise; "big" is the proper word to describe it.

We of the effete East can scarcely understand the bigness of the West, the bigness of Chicago, or the bigness of the World's Fair. After this impression comes a feeling of admiration for the mind that projected the enterprise, and for the ingenious and skillful way in which the plan has been carried out. The buildings to all appearances are built of solid stone and iron, and look good for years of use and wear. The "staff" used in their construction so nearly resembles stone, that it requires a close inspection to tell the difference.

There is no doubt that Chicago is the proper place to hold this exposition, when the question of location of the buildings is considered. The immense park along the shores of the lake forms a splendid site.

Facts and figures regarding the Fair buildings and grounds have been promulgated through the press to such an extent that almost every American reader is familiar to a certain degree with what he expects to find on arriving at the grounds, and yet all that has been written or said in regard to the immensity of the whole plant can in no degree approach the impression gained by the first glimpse of the white buildings and the beautifully designed grounds in which they are set. The whole scheme of the projectors of the World's Fair seems to have been to appeal to the sense of the beautiful. Artistically the buildings are most pleasing, and from a layman's point of view perfectly correct. Wooded islands, bayous and vistas of the great lake meet one at every turn. The ingenious devices and methods made use of to achieve these results are marvelous. The method used in painting the interiors of the immense buildings is extremely ingenious and Chicagoesque. We in the East, when we have a large surface to paint, set a man or men to work with brushes and paint pots to cover it. Not so in Chicago. The many acres of ceiling and wall space which have been covered with paint in the World's Fair buildings were approached in another manner. A diminutive fire department was organized, with engines, pumps, hose and firemen, only the firemen were called painters, and instead of laying on the paint with brushes, it was squirted on. One man is thus enabled to do the work of 10 or 12.

The Electricity Building, in which the readers of the ELECTRICAL REVIEW are more interested than any of the others, is one of the most beautiful of all. It is a symmetrical structure, and as it now stands, empty and clean, would seem to be large enough to shelter the electrical apparatus of the world. It has been no easy task for the Department of Electricity to assign space to the exhibitors who called for it, and yet there have been fewer complaints in this department than in almost any other. It has been the aim of the Department of Electricity to make a representative showing of the electrical arts, and if the present plans are carried out this end will probably be achieved. In one of the departments of the World's Fair the basis for awarding exhibit space was determined by the commercial rating of the companies applying for it. This obviously would be an unfair standard to assume in the Electricity Department, as the industry is so young as not to have acquired that stability which some of the older manufacturing industries have attained. Doubtless there will not be found one exhibitor in the Electricity Building who will secure as much space as he desires. This is natural, of course, and yet I believe it will be found that the electrical exhibits will be the most interesting and entertaining which the visitors will view.

I would advise every ELECTRICAL REVIEW reader who can secure the opportunity to visit the World's Fair before the exhibition is officially opened. Just at this time you can obtain a better idea of the immensity of things than will be possible when the buildings are filled with exhibits and the grounds are covered with turf and flowers and the walks thronged with people. The element of size is the most prominent characteristic of the World's Fair to-day. In the Manufactures Building we have the largest building in the world, supported by the largest steel trusses ever built. There are many more "largest" things and more will be on exhibition during the World's Fair. The immensity of the plant is better realized after one has returned from the grounds with a slight attact of "tired feeling," and begins to think he has walked many miles in viewing the largest undertaking of the times.

FIG. 1.—SPEAKING TUBE TELEPHONE SET FOR HOTEL ROOMS.

Telephone Improvement.

WESTERN ELECTRIC COMPANY'S SHORT DISTANCE TELEPHONE SETS.

In the commercial development of the telephone the long distance work has naturally been the most conspicuous feature. The recent achievements in this direction have attracted the earnest attention of the business community. The application of the telephone to short distance work has been so much in the background that its importance has been until recently generally overlooked.

Perhaps the most interesting application of this apparatus is as a hotel room call. The apparatus used in the room is shown in Fig. 1. In the office is a switchboard. The guest to get into communication with the hotel office simply pushes the button and holds the receiver to his ear. The office will reply and he may give his order. He has the satisfaction of knowing that his call is received and of giving his order instantly and of knowing that it is understood. The guest may also be put into communication through the office with any other room in the hotel. To appreciate the conveniences of this system for hotels, it is only necessary to have had some experience with the ordinary systems. The outfits are not all for the guest, however. For the hotel keeper there are advantages; the clerk can call up any room to ascertain whether a guest is in or to deliver a message, and as it is only necessary to send boys to rooms to execute orders, and not to receive them, there is a considerable saving in their time. The switchboard is a general type and may be so constructed as to fit an ornamental case if desired.

The advantages of the application of this apparatus to intercommunication between offices have been greatly impressed upon business men wherever the system has come under their notice. The following from the Brooklyn *Eagle*, of February 11, describing this system in its offices, illustrates this:

A novel and ingenious improvement in the telephone system, known as the speaking tube telephone, for house and office services, has just been introduced in the *Eagle* building and bids fair to come quickly into general use, a number of large office buildings in this city and New York having already ordered duplicates of the *Eagle's* outfit. The new *Eagle* building is altogether too large for the old-fashioned speaking tube to render satisfactory service between the different branches of the *Eagle* family, and the speaking tube telephone is the result of the New York and New Jersey Telephone Company's effort to overcome this difficulty.

The working of the speaking tube telephone is extremely simple. It hangs on the wall like the old-fashioned local telephones, and the receiver and transmitter are substantially like those of the local telephone, except smaller and less clumsy. Underneath each of them is a small switchboard with 12 holes, allowing for 12 stations and a single plug. The nine stations at present in use represent the president's and secretary's office, the press room in the basement, the business office on the main floor, the business office of the job department on the fifth floor, the stereotyping room on the fifth floor, the press room of the job department on the sixth floor, the city editor's desk, the Sunday editor's desk and the composing room. When not in use the plug of each switchboard is kept in the hole corresponding in number to its own station. For any station of the nine to get connection with any other, all that is necessary is to place the plug in the hole for that station and ring the bell. The telephone does the rest.

The use of telephones in the place of speaking tubes has been, however, gradually developing, and has reached a point where it has justified the designing of a special form of instrument for that purpose by the American Bell Telephone Company, called the "speaking tube set." It may be used for communication between different parts of the same building, as, for instance, between rooms of a hotel, between offices in one building, or between different departments of a factory or warehouse, or it may be used between a house and a stable, or between private residences for social purposes.

The Western Electric Company furnishes to the telephone companies switching and calling apparatus designed for these various purposes, so that any one through his local telephone company may obtain an equipment adapted to his needs.

A variation of this system is illustrated in Fig. 2. The telephone, transmitter and calling apparatus is mounted upon a disk stand, while the switching apparatus for connecting with any other station of the system (shown beneath) is mounted separately to be placed in a pigeon hole of the desk or in any other convenient place.

In Fig. 3 is illustrated the factory system. By turning the key in the center so that the pointer below rests upon the number of the station desired, and pushing the button, the station is called and communication established.

FIG. 3.—SPEAKING TUBE TELEPHONE SET FOR FACTORY USE.—SWITCHING KEY BELOW CYMBALS.

At first thought it appears that the office and factory systems save the time of clerks and office boys. On reflection it appears that they effect the far more important saving of the time of general managers, secretaries, superintendents, etc. The executive officers of large business houses will appreciate the advantage of instant verbal communication with heads of departments. For communication between only two stations

where, of course, no switching apparatus is necessary, and where an ordinary push button and cell is sufficient for calling, the apparatus shown in Fig. 4 may be used.

The above describes the apparatus adapted to fill more common requirements. The system is very elastic and may be varied to fill almost any combination of requirements.

FIG. 4.—SPEAKING TUBE TELEPHONE SET FOR TWO-STATION FACTORY USE.

A peculiar feature of all of these systems is that no battery is required at the several stations, so that the sets are small and compact, and, therefore, there is but little care required in maintaining the one central battery.

A Time-ly Suggestion.

Nothing is more annoying to workers in the electrical field than to be "knocked out of time" by their watches becoming magnetized. Electricians and others whose duties call them among dynamos and electrical appliances require as accurate time as in other walks of life, and, aside from this, it is also important that their watches be exempt from magnetic influence. Paillard non-magnetic watches possess all the merits of the best makes, with the additional advantage of being absolutely non-magnetic, and will not stop even when placed directly upon pole pieces of dynamos. These watches are constructed on the best mechanical principles, the balance, hair spring and escapement being made of any alloy of palladium, instead of steel, as in the ordinary watch. They are made in all sizes and kinds, from the lowest price a good watch can be bought for to the highest, in both plain and complicated.

Thomas A. Edison says of them: "I consider Paillard's balance and hair-spring a most wonderful and valuable invention, not only for workers around dynamos, but wherever accuracy of time is required." A non-magnetic watch is a necessity in these days of electrical progress.

Partrick & Carter—A Thoroughly Reliable House.

"There is very little new under the sun," and there is but little old in this new business of electrical development. One of the few old things in this business is a concern that everybody knows and everybody thinks well of. Partrick & Carter, of Philadelphia, who have been established over a quarter of a century, is one of the old reliable houses. While they manufacture and deal in everything electrical, they make a specialty of hotel and house goods, in which line they take first rank. It gives us pleasure to make mention of such a concern, and we are confident that their record in the future will be a vivid reflection of their past honorable career.

Fuse Wire and Its Use.

The principles governing the action of fuse wire are very simple, yet it is not fully realized that it must be used with an understanding of its nature and with intelligent attention to its action under different circumstances, in order to get from its use all the protection it can give.

Fuse wire is a safety device designed to break the electric circuit when an excessive current passes, but it breaks the circuit because it is heated to a point at which it melts. The fusion necessarily depends upon all the elements that affect this heating. It is even tempered. It hasn't a "hair-trigger character" that flies off if a motorman accidentally starts his car a little too quickly. It allows that, and no harm is done; but if he persists and takes every ampere he can get, on an up grade with a heavy load, the fuse very soon shows that it is there to protect.

The great trouble is that fuse wire is not always used so that it does limit the demand put upon the apparatus. This is due sometimes to ignorance. It is often thought that a fuse of any kind or size will amply protect the system. Often the fuse wire itself is not reliable. It is largely due, however, to the fact that "fifty ampere wire" is not always "fifty ampere wire," be it the most perfect in the world; and all because the fuse blows only when it is sufficiently heated, and anything that prevents this heating prevents the fusing. Every one knows the difficulty there would be in soldering the end of a copper wire to a brick. It is not realized, however, that there is, in varying degrees, this escape of the heat to the brass or copper terminals of a fuse block. The very accumulation of heat required to make the fuse act, is prevented by using such short fuses that an abnormal current is necessary to produce the heat faster than it can be conducted away.

In making links where the length of wire is extremely short, so much depends on the conducting away of heat by the special terminals used, that the only safe way is to make up sample links and test in the cut-out in which they are to be used. The Shawmut Fuse Wire Company, of Boston, does this with all links manufactured by them.

Time also comes in as an important factor in some cases. As the time decreases, the current necessary to fuse increases rapidly, showing the ability of a fuse to stand sudden increases of very short duration. It also shows, however, that on account of this time required to heat the fuse to melting point, one cannot expect it to do the work of an automatic cut-out, which opens the circuit instantly at a given point.

The proper margin between carrying capacity and ultimate fusing point is rather important to determine, and it varies, of course, with the uses to which the apparatus is put. Where the currents are small, as in certain branches of lighting systems, it makes little difference if the margin is high, since when the fuse blows it is usually because of a short circuit, and for mechanical reasons there is no wire used in the system that is not too large to be unduly heated before the fuse acts. In some motor work, however, and with small dynamos, it is often wished to limit the current that can be delivered, to very near the maximum working load. In this case the margin is made only 20 to 30 per cent.; enough to prevent the fuse from becoming dangerously hot when carrying the normal current, and also enough to allow for reasonable increase in the temperature of the air about the fuse, which would cause it to blow slightly lower.

With railroad work, however, where motors are built to stand very heavy currents continued for several seconds, the margin may be much larger. It should usually be 50 per cent., and may sometimes be more, if there are heavy grades on the road. A fuse that would blow very near the carrying capacity would cause trouble every time a loaded car was started, and every time a grade was taken. Since the motor is designed for heavy work and unusual demands, the fuse should be so calculated that it will act in accordance and simply protect against injury.

If one will but give the attention to his fuses that he gives to other details, they may be made accurate and reliable safety devices, but they cannot be depended upon if used in a haphazard way without judgment and attention to peculiar circumstances. One should know what the wire will do under different conditions, and choose the size in accordance with them.

Wires are not heated to an unsafe temperature instantly, nor do machines become unduly heated instantly. A proper fuse will be destroyed first, and so protect the system.

If sudden increases in current cause other serious troubles, an automatic cut-out is wanted—not a fuse.

The Shawmut Fuse Wire Company gives in its certificate of test the proper length for each size wire, and the fusing point and carrying capacity for this length. If a shorter fuse must be used, find from the curves the action of the different sizes, and choose one of such diameter as will fuse at the point required. A large variety is kept in stock, and a wire varying but little from any diameter named can always be furnished.

Two More Long Distance Cables Across the Hudson.

The Metropolitan Telephone and Telegraph Company have arranged with the Kerite Company to place two more of their armored cables across the Hudson river between New Jersey and New York. These cables are to be used with the long distance lines between here and Chicago, and make nine in all that have been laid by the Kerite Company for this work. It should be considered quite a feather in the cap of this cable manufacturer to be able to supply the exacting requirements of such work.

A Wise Company.

June 1, 1891, the American Watch Tool Company posted the following notice:

"At the conclusion of 10 years' consecutive service in the employ of this company, employés will receive a present of 10 days' pay, and the same amount at the conclusion of 15 years."

Since that time they have paid 18 employés the 10 and three the 15 years' bonus. In 1892 they paid five the 10 and two the 15 years' bonus; and in 1893 there will be three to be paid the 10 and three the 15 years' bonus. If other employers would adopt this plan and treat their employés in a courteous and generous manner, there would be longer service and less or no strikes.

The Electric Plant of the Laclede Gas Light Company, St. Louis.

The Laclede Gas Light Company operates both a gas and electric light plant in the city of St. Louis. The electric plant occupies a very favorable location on the banks of the Mississippi, at Mound street and the Levee, and furnishes current for commercial lighting, city alley lighting and public building lighting north of Washington avenue. The superintendent of the plant is Mr. F. G. Schlosser.

Steam is furnished from three Heine boilers of 314 horse-power each, at a pressure of 150 pounds. A Ludlow feed-water heater of 100 horse-power is also used. In the floor of the boiler room is a hot well for condensing purposes. The boiler room is separated from the engine room by a solid brick wall. The building is of brick, 150x110, and is two stories high.

Power is supplied by two Williams triple expansion engines of 250 horse-power each; one single cylinder Buckeye 150 horse power engine; one Buckeye cross compound engine of 375 horse-power and two Armington & Sims cross compound engines of 350 horse-power each.

The two Williams engines are connected by a line shaft equipped with 14 Eclipse clutches. Belts are carried up from this shaft to the dynamo room on the second floor, rope transmission being used. The balance of the engines are belted direct to the dynamos with Hoyt belts.

The electrical equipment consists of three 1,200, one 720 and two 3,000 light Brush alternating dynamos operating at 2,000 volts. These machines furnish current for commercial lights. Besides these there are four 900 light Heisler generators which furnish current for the alley lights. The Laclede Gas Light Company also operates generators which form the power plant for another company.

The Heisler switchboard is a slate, plug board, equipped and operated with the regular Heisler devices. The Brush switchboard is of slate and is also of the plug type, with automatic circuit breakers for the machines. No fuses are used on this board.

The longest Brush circuit is 12 miles in length and the longest Heisler circuit is about 30 miles in length, while all six circuits running from this plant are between 20 and 30 miles long. No "boosters" are used on the alternating current lines.

FIG. 2.—SPEAKING TUBE TELEPHONE SET FOR BUSINESS OFFICE.—SWITCHING APPARATUS SHOWN BENEATH.

The Durability of Underground Wires.

BY HERBERT LAWS WEBB.

It is now several years since American electrical engineers, much against their will, began to have experience with underground wires. Records of the four or five years' experience that has already been had are neither very plentiful nor very satisfying, and there is a great dearth of information on a subject which must be of vital interest to all electrical engineers having works under their charge in large cities. Unfortunately, the subway systems in all American cities are necessarily subject to the control of the local politicians who govern those cities for their own benefit, and, consequently, the confusion and corruption below the pavement are only equalled by the confusion and corruption above it. That some companies are allowed to lay their own pipes and wires, and others forced to use the high-priced conduits built by order of the city rulers, is an anomalous state of affairs that naturally grows from the control of scientific and engineering works by persons entirely ignorant of scientific and engineering matters. It would be quite as unprofitable, then, to discuss the question of subways as to discuss the question of street cleaning, since both are subject to local political misrule.

While the class of underground electric wires or cables used, of course, greatly depends on the style of conduit into which they are to be placed, still, it is not impossible to separate, to a certain extent, the question of wires from the question of conduits. At all events, it is quite possible, and may be profitable, to take the conduits as they are and see how the wires are behaving under existing conditions.

There is very little variety of practice as regards underground work in this country. We have the Edison tubes, which in some cases are buried directly in the ground, and in others placed in larger iron pipes for additional protection; and we have the wrought iron conduits, of which New York and other large cities now have many hundreds of miles, and which can be used for containing insulated cables of all kinds. There are other styles of conduits, such as the Lynch Lake, that has been adopted at Washington, creosoted wood conduits, and various more, but the amount of all other kinds in use is slight compared with the amount of wrought iron pipe ducts laid down. Nobody but the Edison illuminating companies lay their cables directly in the ground. This is standard practice in Europe, where a special type of highly insulated cable, armored with iron, is made which is buried in a comparatively shallow trench, and will stand any amount of heavy traffic without suffering damage. The iron armoring is not after the style of a submarine cable, but is made of two iron bands or strips laid on helically and slightly overlapping. This makes a very strong and durable sheathing, and it gives a lighter and more flexible cable than wire armoring. This class of cable is not used at all in this country, although it could be advantageously employed in many places, as it gives remarkably cheap construction.

Another class of underground work used in England for low pressure systems is the arrangement of wires or strips supported on porcelain bridge insulators in a shallow culvert. This system has not proved in practice so successful as was predicted when it first came into use, owing to the difficulty of keeping the culverts properly drained and the insulators free from moisture. Otherwise the system has great advantages of accessibility and flexibility (in the sense of the ease with which the carrying capacity may be added to) of the conductors.

The three-wire tubes put down by the Edison illuminating companies form the standard style of underground work for low pressure distribution in this country. It is well known that the insulating qualities of the dielectric used, are very poor and the loss of current by leakage is enormous. In a low pressure system, there is no danger to life, of course, from a generally low insulation, and the loss of current by leakage concerns only those who own the plant.

The cables used in the subways are of several different classes. As a rule they are lead covered. The insulating materials used are all kinds of rubber compounds, fibrous materials impregnated with resinous and bituminous compounds, and dry paper. This last material is used chiefly for telephone cables on account of the low electrostatic capacity obtained, but it has also been used with some amount of success for electric light work. Where very high pressures are concerned, however, there is little doubt that the only dielectric that will give enduring satisfaction is the highest grade of vulcanized rubber.

A lead-encased cable properly laid and jointed, protected by a wrought-iron duct is a very durable underground conductor. The lead covering, which is generally alloyed with 3 per cent. of tin, is practically indestructible, as far as any corrosive influences met with underground are concerned. It has not very much mechanical strength, and mechanical injury, either wanton or accidental, has been the chief source of trouble to which breakdowns in the underground cables in New York have been traced. Very few failures due to internal causes have occurred, and this speaks well for the general excellence of manufacture of the cables. There are some 400 telephone cables underground in New York, all of which are practically dependent on the continuity of their lead covering for their insulation, yet very few failures have happened. Any break in the lead pipe results in a rapid fall in insulation, quickly amounting to a "dead ground;" almost all of these troubles have been definitely traced to an injury inflicted on the lead pipe, either carelessly or unknowingly.

With rubber insulated cables, damage to the lead pipe does not necessarily result in loss of insulation unless the rubber coatings are cut or punctured at the same time. Very few cases of this have occurred; one or two have evidently been the result of malicious work on the part of some one well acquainted with the peculiarities of electric cables.

As to quantitative data on the durability and cost of maintenance of underground cables, there are practically no data existing. Although such information would be of great interest and practical value to a large circle of electrical engineers, those having the means for supplying it generally prefer to keep it to themselves. This is a pity as the practice of each company differs to a certain extent according to the ideas of those in charge and the local conditions, and the results probably also differ in many respects. It would be very interesting to have a free exchange of views and opinions based on experience relating to this highly important subject. The object of this fragmentary and inconsequential paper is rather to provoke such a discussion than to give information.

It is unquestionable that underground electrical construction has become firmly established in America, and the methods of putting down wires have already become standardized to a certain extent. What we now need is quantitative information as to the cost, qualities, durability and general behavior of the cables under different conditions.

An Important Aid in all Branches of Electrical Work.

The good repute which the "P. & B." compounds enjoy among electrical people who have tested and are using them induces their manufacturers to bring the same directly to the attention of all interested in any branch of electrical work. The compound so readily recommends itself that a trial of the same is all that will be necessary to convince consumers of its merits. It is a very quick dryer and a good body coating; is a complete preservative for wood, iron, brick, or fabrics of all descriptions; makes surfaces thoroughly waterproof, and resists the strongest alkalies and strong acids. It possesses high insulating properties. These properties have been demonstrated in many directions. The following is one of many testimonials received:

AMERICAN TELEPHONE AND TELEGRAPH CO., NEW YORK, Dec. 29, 1888.

MR. RALPH L. SHAINWALD, *President Standard Paint Co.*

DEAR SIR—In answer to your inquiries as to how we like the P. & B. Paint which we have been using for the past two years on our underground work in Philadelphia, also on the cables which have been run in the conduits in Philadelphia, would say that it has given us the very best of satisfaction, and the underground gases do not seem to affect it in the least. Up to this time we have not found anything that equals this Paint for underground work.

Very respectfully,
W. H. FAIRBANK,
Gen'l Supt. Const.

The New Ship of the Morgan Line.

The "El Rio," a new ship built at Newport News, Va., for the Morgan line, to ply between New York and New Orleans, was given her trial trip Wednesday of last week in New York waters. A large party of steamboat and newspaper men went down the bay, General Agent Van Sickle doing the honors, providing a very enjoyable luncheon. The "El Rio" is designed to carry 4,600 tons, is built in the most modern style, containing all electrical improvements, and is said to be the finest freight steamer ever constructed.

Brainard Rorison.

PRESIDENT LOUISIANA ELECTRIC LIGHT COMPANY AND SECRETARY AND ASSISTANT GENERAL MANAGER FORT WAYNE ELECTRIC COMPANY.

One of the most successful men in the electrical field to-day is Mr. Brainard Rorison, who is prominently identified with the Fort Wayne Electric Company, of Fort Wayne, Ind. His keen foresight and good business methods have enabled him to secure a goodly share of this world's best things.

His attention, in common with many others, was several years ago attracted to the electric business, and in 1885 he secured the services of Chas. D. Jenney, and, with Nordyke & Marmon, organized the Jenney Electric Company and engaged in the manufacture of electrical apparatus of the Jenney system. He was the general manager and active head of that concern during the four years of its existence during which it was very prosperous, its operations extending over the Middle and Southern States and the Pacific Coast. Mr. Rorison has always made it a rule to become a stockholder in any enterprise which he fostered.

In 1889 the indications were so strong that the Brush patent would be declared valid, that, acting for himself and partners, he sold the company's stock to the Thomson Houston Company, after which the Jenney, together with several other companies was merged into the Fort Wayne Electric Company. He then became, and has since been, the secretary and assistant general manager of that company.

BRAINARD RORISON, A SUCCESSFUL ELECTRICAL MANUFACTURER.

He has also been for several years president of the Louisiana Electric Light Company, long known as the largest lighting station in existence. This plant with a capacity of 7,000 horse-power is said to have cost upward of $1,500,000. It does practically all of the electric lighting in New Orleans, and is being enlarged to furnish power for the new electric railways in that city.

The Electric Selector and Signal Company.

With the assent of 99 per cent. of the stock and bondholders of the Electric Secret Service Company, all of the property, patents, business and good will of that company were sold by C. P. MacKie, receiver, on February 11, 1893, to the Electric Selector and Signal Company. This new corporation has likewise acquired other important inventions relating to the general subject of electrical selection, and proposes to develop this especial business as applied to telegraphs, block signals, electric light and power and telephones in this country and abroad, on a larger scale than the company which it succeeds. The change has been effected without interruption to the business of the Electric Secret Service Company, and upon terms which, it is said, provide for a settlement of all of that company's obligations in full in cash. The Electric Selector and Signal Company will, we understand, have the same technical management as the Electric Secret Service Company, although its board of directors will contain several new and influential names.

ELECTRIC LIGHT AND POWER NOTES.

Judge Bartlett, of the Brooklyn Superior Court, has granted an attachment against the property in this State of the River and Rail Electric Light Company as a foreign corporation. It is the outcome of a suit for money due a creditor.

One of the large 250 horse-power generators that has been in course of construction at the Eddy Electric Company's factory for several months past has been tested, preparatory to its shipment to Chicago. This company furnishes two of these large machines each weighing 18 tons, and several of less power and weight, for lighting some of the buildings of the World's Fair.

Justice Brayton, of Chicago, has fined the Chicago Illuminating Company $25 for violating the smoke ordinance. The defense was the impossibility of getting a good quality of coal owing to the present lack of fuel in the yards. The company promised to improve the smoke-preventing devices in use in the plant, and in view of these facts the court did not impose the full penalty.

City Engineer Rosewater, of Omaha, Neb., has figured out the relative cost of gasoline and electric lamps for lighting the streets. He finds that even if the city were to take up the Thomson-Houston offer of 1,200 candle-power lights at $90 it would be cheaper than gasoline and more reliable. The saving in cost is figured on the number of gasoline lamps which each electric light would displace.

Another obstacle has been removed in the matter of securing a municipal plant for Detroit, but it is claimed that it takes a strong offensive weapon out of the hands of the big trust. The patents on the towers of the electric light combine have frightened many would-be competitors of the Fort Wayne people who have won many infringement suits based upon them. Now it is declared that these patents are valueless, for the main principle upon which the combine rests its claim to patent rights—the single base—was patented in England in 1868, 15 years before the Adams patent was taken out in the United States.

Marquette, Mich., is a living instance of what improvements in electrical enterprises can do for a growing city. The total investment has been but somewhere in the neighborhood of $75,000, and the plant includes a dam, which raises the water to 27 feet above the point of discharge; two Brush arc dynamos and two Westinghouse alternating current incandescent dynamos; 30 miles of No. 4 copper wire on two arc circuits; about the same length of incandescent mains; and the usual machinery. Notwithstanding the fact that the incandescent service is less than half what it might be with ample power, the city derives a handsome revenue from that source. Nearly 1,700 incandescent lights are in use.

Queen & Company.

Queen & Company, Incorporated, Philadelphia, are congratulating themselves upon the increasing demand for their "Magnetic Vane" ammeters and voltmeters as evidenced by the fact that more than twice as many of these instruments were sold by them in 1892 than in the preceding year. This advance is perhaps not astonishing when efficiency and cost of the apparatus are considered, but it shows a degree of appreciation on the part of the purchasers that is very significant. The "Magnetic Vane" instruments are adapted for constant switchboard use, and voltmeters as well as ammeters can be left in circuit constantly, a feature of great importance to the central station manager. The makers are manufacturing in large quantities to supply demands which come from all over the United States. A number of prominent dynamo building companies have adopted the above type to install with isolated plants for incandescent lighting and for power circuits.

Descriptive circular No. 420 recently issued by Queen & Company, contains further information of value and will be mailed upon application.

Risked His Life for Science.

REMARKABLE VENTURE OF DOBROWOLSKY AT LAUFFEN—DISCUSSION OVER THE QUESTION OF GROUNDING THE NEUTRAL POINT OF ELECTRIC LIGHT AND POWER LINES.

At the last meeting of the Berlin Elektrotechnische Verein, January 31, 1893, a very interesting and prolonged discussion took place between Privy Councillor Grawinkel, Wm. v. Siemens, and v. Dolivo-Dobrowolsky. The point under consideration was the danger to life and property inherent in the use of uninsulated conductors for light and power lines.

Mr. Grawinkel, as the representative of the German postal department, insisted upon the great danger to which telegraph and telephone lines throughout the country would be subjected if uninsulated conductors were employed in the construction of electric light and power lines. According to his opinion, such lines should be kept from any earth contact, or ground, this being the best safeguard against accidents.

In reply to Grawinkel's remarks, Mr. Wm. v. Siemens pointed out that though everyone admitted that there was a certain amount of danger in the use of uninsulated conductors carrying high potential or large quantity low potential currents, nevertheless the question to be considered should not be the danger, but the inter-relation existing between the probable risk and the cheapened cost of power for commercial purposes. This point he illustrated by drawing a comparison between electric lines and railroads. It was well known that the safety of railroad travel could be much improved by the use of heavier rails, by universally employing block signals, and by adding a second or outside track to every existing railroad, yet the State is unable to add such improvements for the simple reason that business has to be done upon a paying basis and not upon theoretic precepts.

Mr. Siemens was followed by the ardent sponsor of the new electric power industry, Mr. v. Dolivo-Dobrowolsky. Space does not permit us to quote his remarks entire. We desire, however, to call special attention to his remarks regarding the merits or demerits of grounding the neutral line conductor. Concerning this point Mr. v. Dolivo-Dobrowolsky spoke as follows:

Another demand is the prohibition of earth contacts, apparently, because such artificial grounds are a source of danger. My own opinion is that this authoritative demand is based upon the somewhat greater expense required for the construction of metallic telephone and telegraph lines employing this plan. But the grounding of the neutral conductor is peremptorily demanded on account of safety. This necessity is accentuated in aerial electric installations for the transmission of high potential currents. In spite of the authorities cited, I contend that the grounding of the neutral conductor is the greatest possible safeguard against danger of any kind.

Without such an arrangement of first-class grounds I would have fallen a victim to the Lauffen-Frankfurt power transmission. The local authorities demanded that the promoters of the enterprise should take every possible precautionary measure to avert danger to life and property. Among other things, they required the actual proof that, should a conductor break and fall down upon the adjacent railroad track, such conductor could be touched and removed with entire impunity.

Having this point in mind, I placed a sufficient number of fuses in the low as well as high voltage portion of the line. Again I interposed several electro magnetic minimum and maximum cut outs upon the principal switchboard and finally connected the neutral points of both windings of the transformer coil with a first-class ground. The conductor I employed for this earth connection was a copper cable, deeply immersed in the river Neckar, the idea, of course, being that should a short circuit take place on any part of the line the fuses would at once act, thus instantaneously depriving the line of current.

At the examination of the experts, detailed by the State to inspect the line, I requested some of the gentlemen to remain at the generating station and then invited the rest of the company to accompany me to a point on the line where arrangements had been made for cutting a portion of the conductor while carrying the high voltage current and throwing the wire upon the adjacent railroad track.

As soon as the conductor touched the rails, a great flame seemed to leap from the ground.

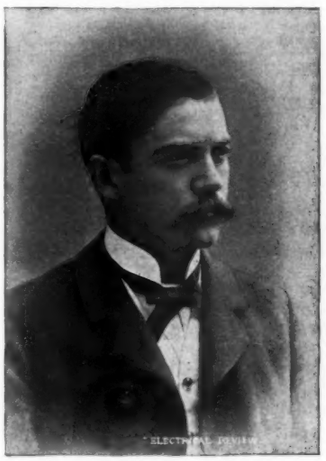
I immediately went to the spot, lifted the conductor off the rails, and thus convinced the experts of the safety of our line construction.

A failure to ground the neutral point of the line at the Lauffen transformer and that attempt of mine would have been my *last earthly electrical experiment.*

In that case, even though the current did not continue to flow, the electro-static capacity of the line would have been sufficient to kill me instantaneously.

I ask you, gentlemen, who would have been willing to touch that conductor, carrying 20,000 volts, even though surrounded by the very best insulating material?

In conclusion, we add the interesting remarks of Postal Councillor Wabner, a gentleman well known to American electrical engineers. He stated that in Berlin the first disturbances in the telephone service took place in the middle of July, 1890, and continued as follows:



MR. CHAS. A. BALDWIN, PRESIDENT MASSACHUSETTS CHEMICAL COMPANY.

In 1891 the statistical record showed 93 disturbances, while the current year was remarkable on account of the very pronounced decrease of such phenomena. In fact no disturbance happened during the month of August. The question, naturally, was forced upon me, What is the reason of the sudden disappearance of the formerly serious disturbances of the telephone service? This I explain as follows: It is well known that the General Electric Light Company has lately introduced the three-wire system, employing the old cable conductors (formerly used as the negative conductor) as the neutral wire. But, as the insulation of the former negative conductor was by no means perfect, and, assuming some additional leakage in the positive conductors, the formerly observed disturbing phenomena are fully accounted for. As far as I am concerned, the statistical data leads me to the opinion that the electric light and telephone service may be carried on without in any way interfering one with the other.

To Interest Railway Employes in their Work.

At a recent meeting of the railroad officials of East Cleveland, O., the following proposals were acted upon and adopted:

The fare is still 5 cents, but tickets will be sold hereafter 6 for 25 cents, or 35 for $1.

The old rate was 11 for 50 cents and 22 for $1.

The reduction will take effect as soon as the new tickets can be printed, which will be in about two weeks. The dollar package will resemble the present pass books, and the quarter arrangement will resemble the present half dollar strips.

The directors also decided to give the motormen and conductors something to work for, and decided to offer $3,000 in prizes for carrying out the rules of the company and avoiding accidents. The award will be made on July 1, 1893, and January 1, 1894, $1,500 being distributed at each award, as follows: Fifty dollars as a first prize to each of 10 motormen, and $25 to each of 10 motormen as second prizes; $50 to each of 10 conductors as first prizes, and $25 to each of 10 conductors as second prizes.

In order to determine who are entitled to the prizes, a careful record of each man's services will be kept, and all accidents and complaints will be noted. The records will be submitted to a committee consisting of one man selected by the company, one selected by the employés, and a third chosen by the two. This committee will make the award of prizes.

The Massachusetts Chemical Company, Boston.

The Massachusetts Chemical Company has attracted so much attention by the great merit of their Insullac, and by their vigorous and original advertising, that we take pleasure in offering this short sketch of their record.

The company's plant was put in full operation in July, 1892, prior to which date their experimental work had extended over several years.

Insullac was a great surprise to its makers, for while its conception and birth were the result of well defined principles, not even the most sanguine believed the full powers of the infant prodigy would be so soon demonstrated and understood. Now it is being used by nearly every electrical company in North America, and its fame has crossed the Atlantic, and reached the southern hemisphere. Four times the company has been forced to increase the capacity of its plant, and now the erection of another factory in the vicinity of New York in the near future is an assured fact.

The company has been especially fortunate in its representation throughout the country. Col. J. Frank Dillont is the manager of the Massachusetts Chemical Company's New York branch. Harry Bishop is well known in the electrical trade, and his advent as general western agent at Chicago marked an era in the company's business. He will attend the convention at St. Louis.

During the last three months the company has been in receipt of many congratulatory letters from prominent electricians and electrical companies, several of which have been published and which attracted a great deal of attention.

Mr. Charles A. Baldwin, president of the company, is well known in electrical circles, is a member of the banking and brokerage house of Baldwin Brothers, and is noted as a man of rare executive ability, careful and conservative whenever conservatism is needed, and vigorously aggressive all the time.

Mr. C. E. Farrington, general manager, is the man who first conceived and produced Insullac, as well as the many other materials manufactured by the company. His studies in the field of insulating materials and chemical science have been assiduously far-reaching, and the wonderful results already produced are but the advance guard of others soon to be made public.

MR. C. E. FARRINGTON, GENERAL MANAGER MASSACHUSETTS CHEMICAL COMPANY.

The motto of the company is "*Nemo superabit*" (None shall excel), to which Mr. Baldwin adds "or undersell." They have done great things already for the electrical industry, and their labors have been and are substantially appreciated.

The resolution introduced in the Senate of the State of New Jersey by Mr. Cornish, to investigate the methods of the telephone companies, practically calls on the companies to tell how much stock they have out, who owns it and how much the annual dividends and profits amount to. Mr. Cornish declares that the resolution was introduced in the interest of several manufacturers. He contends that the charges in New Jersey are excessive, and that the large companies are making, as he expresses it, "terrible profits." He will know more when he gets the information sought.

Programme of the St. Louis Convention

The following programme of the sixteenth convention of the National Electric Light Association, which meets at St. Louis February 28, March 1 and 2, has been arranged:

TUESDAY, FEBRUARY 28, 1893.

Meeting of the Executive Committee at 9 A. M., parlor, Southern Hotel.

MORNING SESSION, 10.30 O'CLOCK.
(Bell Telephone Building.)

Address of Welcome, Hon. E. A. Noonan, Mayor of St. Louis.

Address, President Jas. I. Ayer.

Report, Committee on Data.

AFTERNOON SESSION, 2 O'CLOCK.

Report, Committee on Safe Wiring.

Report, Committee on World's Columbian Fair.

Paper, A. D. Adams, "Wrought *vs.* Cast Iron for Field Magnet Frames."

WEDNESDAY, MARCH 1, MORNING SESSION, 10 A. M.

Paper, Prof. George Forbes, "Thermo-Storage For Central Stations."

Paper, Chas. S. Bradley, "Long Distance Transmission of Power."

Paper, L. B. Stillwell, "Under What Conditions is the Use of Water Power Economical?"

AFTERNOON SESSION, 2:30 O'CLOCK.

Paper, E. A. Armstrong, "Morals of Corporations."

Paper, R. H. Sterling, "Some Experiences with the Alternating System."

Paper, William Brophy, "Relation of Insurance to Electric Lighting and Power."

EVENING SESSION, 8 O'CLOCK.

Lecture by Nikola Tesla.

THURSDAY, MARCH 2, MORNING SESSION, 10 O'CLOCK.

Paper, W. H. Browne, "Underground Conduits and Conductors."

Paper, Calvert Townley, "Incandescent Lamps from a Commercial Standpoint."

Paper, Dr. Louis Bell, "Power Transmission For Central Stations."

AFTERNOON SESSION, 2:30 O'CLOCK.

Paper, H. C. Myers, "Preservation of Poles and Cross Arms."

EXECUTIVE SESSION.

Report, Secretary and Treasurer. Election of Officers.

Master of Transportation C. O. Baker, Jr., is endeavoring to make arrangements with the railroads for a reduced rate of fare between St. Louis and Chicago, as it is thought that many of the delegates to the convention will desire to visit Chicago and the World's Fair buildings.

The special train for St. Louis leaves New York, via Pennsylvania System, Sunday, February 26, at 12 o'clock, noon.

TELEPHONE NOTES.

Mr. M. J. Carney has been appointed assistant general superintendent of the Central Union Telephone Company, *vice* Mr. J. E. Zeublin, resigned to accept the general superintendency of the Chicago Telephone Company.

The Bell Telephone Company of Missouri originally started out with the small capital of $50,000 in 1878. The capital of the company is now about $400,000. On the present large capital they pay eight per cent. dividends annually, and the stock is quoted at $190 per share. This price, to the original purchaser of the company, means a four-fold doubling of their original investment at least, and regular eight per cent. dividends on their holdings.

The Central New York Telephone and Telegraph Company held its annual election of officers in Utica, when these directors were elected: Martin A. Knapp, of Syracuse; David B. Parker, of New York; A. Cadwell Beldon, of Syracuse; Charles H. Lawrence and Francis G. Wood, of Utica. The directors then elected R. S. Williams, president; L. H. Lawrence, vice-president; F. G. Wood, secretary and treasurer; C. A. Nicholson, general manager. The safety of their system had been greatly increased by putting in a fusion block with each instrument. The company has in use at the present time 7,247 telephones, 1,769 miles of wire in operation in the exchange system, and 3,325 miles of wire for their toll lines. The dividend during the year was seven per cent. on the capital stock.

ADVANCE INFORMATION.

New Electric Companies Formed and Important Constructions Projected.

VALUABLE INFORMATION FOR MANUFACTURERS AND DEALERS.

We publish below the earliest information obtainable relating to new electric railways, new electric light companies and projected electric construction of all kinds. Every reader will find these columns of special interest, and manufacturers and supply houses will receive many valuable suggestions looking to new business by carefully watching this department in the ELECTRICAL REVIEW from week to week:

New Electric Railways.

HARRISBURG, PA.—Application has been made at the State department for a charter for the People's Traction Company, of Philadelphia. The incorporators are R. Nelson Buckley, Wm. H. Shelmerdine, J. Lowber Welsh and Edw. J. Matthews.

PHILADELPHIA, PA.—The Merion Avenue Passenger Railway Company; capital, $50,000. Incorporators, Frank S. Harrison, James A. Campbell, J. Clayton Erb and Wm. L. Kite. The Jackson and Porter Street Passenger Railway Company, capital, $50,000, has been incorporated with the same directors as the Merion avenue line. Both roads will adopt the overhead trolley.

WATERFORD, N. Y.—The work of constructing an electric railway from Waterford to Mechanicville and Fort Edward is expected to commence early in the spring. The road will be constructed under the management of the Electric Construction Company, of Lansingburgh.

ISHPEMING, MICH.—The Cleveland, Cliff and Lake Angeline Iron Companies have signed contracts with the Thomson-Houston Company for complete underground electric traction plants costing $50,000 each.

ATHOL, MASS.—The Boston parties who propose to build an electric railway to Orange have elected a temporary board of directors as follows: E. P. McPherson, of Cambridgeport; Chas. H. Utley, of Brookline; F. A. Dexter, of Orange, and Lucien Lord, of Athol. It is understood that should a franchise be granted work will begin at once. There is going to be a lively contest for the electric railway franchise. Another company is being organized by Galen C. Moses, of Bath, Me., for the purpose of building an electric line over the same route. The proposed capital is $60,000.

CHICAGO, ILL.—August Rieke, F. W. McNally and William Kilpatrick have incorporated the North Side Electric Street Railway Company; capital, $500,000. The object is to build an electric railroad (using the storage battery system) between Chicago and Milwaukee.

MCKEESPORT, PA.—The McKeesport and Wilmerding Electric Railway Company has closed contracts for constructing and equipping its road between McKeesport and Wilmerding. In North Versailles township the company will build an electric light plant.

MONTREAL, CAN.—A syndicate, consisting of David Yulle and others, has concluded arrangements for the operation of an electric street car line in Cote St. Antoine.

UPPER SANDUSKY, OHIO.—J. K. Tillotson, of Toledo, is arranging with citizens for organizing a railroad company, with a capital of $2,500,000. It will be known as the Put-in-Bay Southwestern Railway, and will operate between the larger towns in northwestern Ohio and Put-in-Bay Island. The road will be 100 miles long and electricity will be the motive power.

SOUTH PARIS, ME.—Steps have been taken to incorporate by act of legislature a company which proposes to build an electric railway from South Paris through Norway, Harrison, Waterford and North Bridgton, a distance of 20 miles.

SHREWSBURY, MASS.—The Worcester and Shrewsbury Street Railway Company has petitioned for a franchise to build an electric road through the town.

INDIANAPOLIS, IND.—Byron K. Elliott has petitioned the board of works, on behalf of a new street railway company, for a franchise over certain streets in the city.

PHILADELPHIA, PA.—It is reported that the Fifth and Sixth Streets Street Railway Company has secured control of the Second and Third Streets line.

FONDA, N. Y.—The Fonda and Fultonville Electric Railway Company, to operate an electric line from Fonda to Fultonville, a distance of one and a half miles; capital, $100,000. Directors, Wm. P. Myers, Edward Wemple, of Fultonville; J. L. Hers, of Fonda; James S. Burr, of Gloversville, and others.

CHITTENANGO, N. Y.—An electric railroad is to be built from the Springs to Chittenango station, and the streets of the village are to be lighted by electricity.

STONEHAM, MASS.—The Mystic Valley Street Railway Company, capital, $50,000, has been organized to build a new electric railroad from Stoneham through Winchester to Arlington.

ATCHISON, KAN.—New York capitalists have under consideration the purchase of the Atchison street railway, with a view of converting the same into an electric road.

GALLITZIN, PA.—An electric light company has been formed at Gallitzin, and a charter will be applied for immediately. Hon. M Fitzharris, Thomas Bradley and J. L. Mitchell are stockholders.

JOHNSTOWN, N. Y.—The gentlemen interested in the Cayadutta electric railroad have decided to extend their line between Fonda and Fultonville, to connect with trains on the West Shore road. To this end the Fonda and Fultonville Electric Railroad Company was recently organized. The capital stock of the new company is $100,000, of which $15,000 has been subscribed. Work on the road will commence early in the spring. The following directors have been elected: Hon. James Shanahan, Tribes Hill; Hon. Edward Wemple, A. Z. Wemple, William Wiles, Wm. P. Myers, William Van Epps, Charles Rickard, Fultonville; J. Ledlie Hees, Fonda; James P. Argersinger, John G. Ferres, James I. Younglove, Johnstown; T. C. Frenyear, G. Levor, James S. Burr, A. J. Zimmer, Gloversville. By this move the Cayadutta people have secured a combination of roads that certainly should pay them. They will control, besides the main line, the belt line in Gloversville, a loop in Johnstown and the extension to Fonda. Supt. T. C. Frenyear has issued a circular letter to the business men of the vicinity, calling attention to the facilities of the new road when it shall have been completed.

CHATTANOOGA, TENN.—The new electric railway company, represented by G. C. E. James, W. Warner, Xen Wheeler and others, has made application for a charter.

MICHIGAN CITY, IND.—The Lake Cities Electric Railway Company has prepared plans for a power house.

CLEVELAND, OHIO.—Plans have been prepared for almost doubling the capacity of the big power house of the East Cleveland Railroad Company.

KNOXVILLE, TENN.—The West End Street Car Company has petitioned for leave to equip its lines electrically.

WAUSAW, WIS.—The city council has voted to grant an electric street railway franchise to Hiram Dunfield, B. E. Jones and J. D. Ross. Work is to commence in June.

SPRINGFIELD, ILL.—The Pinkham Car Track Sander Company, capital, $150,000, has been incorporated by H. Clay Wilson, John G. Friedmeyer and Benjamin Knudson.

ROME, N. Y.—The citizens have completed their subscription of $21,000 for the purchase of the Rome City Street Railway. The property will be acquired in behalf of the subscribers by A. C. Kessing, trustee. The road has been operated with horses but electricity is contemplated.

Electric Light and Power.

LYNN, MASS.—The Lynn Gas and Electric Company is having plans drawn for a plant more than double the size of the present one, and costing about $150,000.

WYANDOTTE, MICH.—Wyandotte will own its electric light plant. Bids will soon be received.

SEGUIN, TEX.—Seguin is to have an electric plant, to be put in by H. Froell.

CLEVELAND, O.—The Elliott Electric Company; capital, $35,000, Incorporators, J. Emmett Elliott, E. H. Hopkins, F. M. McMillan and Wm. H. Elliott.

FAIRPORT, N. Y.—The village electric light plant has been destroyed by fire.

NORTHAMPTON, MASS.—An expert has been engaged to look over the Northampton electric lighting plant for the purpose of ascertaining what can be done in the way of arranging the works so as to apply power.

CHICAGO, ILL.—The Crescent Electric Light, Heat and Power Company; capital, $100,000. Incorporators, Joseph R. Bickerdike, Tracy D. Hull and Burton Johnson.

AUGUSTA, ILL.—The Augusta Electric Light and Manufacturing Company; capital, $16,000. Incorporators, Wm. Golm, B. B. Garn, D. P. Coffman and O. L. Pitney.

NATICK, MASS.—The directors of the Natick Electric Light Company are talking of organizing a stock company to build an electric line between Natick and Needham, to be operated by power from the electric light plant.

LANCASTER, PA.—The Citizens' Electric Light, Heat and Power Company; capital, $100,000. Incorporators, J. L. Steinmetz, Chas. A. Lockert, Jefferson E. Kershner and S. B. Moss.

ROCKLAND, ME.—The Knox Electric Company; capital, $200,000. President, G. E. Macomber and treasurer, A. D. Bird. The corporation is a consolidation of the Rockland and Thomaston Gas Light Company, the Camden and Rockport Electric Light Company and the Thomaston and Warren Electric Light and Power Company.

NEWARK, N. J.—The Beers Electric Fan and Motor Company; capital, $100,000. Incorporators, Erastus Hayes and A. R. Bradley, of New York; Wm. M. Tallman, of Plainfield, and Franklin H. and Wm. P. Beers, of Newark.

EAST LIVERPOOL, OHIO.—The Swaney Electric Company has been incorporated with a capital stock of $10,000.

NEW YORK CITY.—The Electrical and Mechanical Engineering and Trading Company; capital, $150,000. Directors, Jonathan H. Vail and Geo. F. Sandt, of Westfield, N. J.; James H. Miller, of Mount Vernon; H. W. Weller, of Jamaica, and Uriah T. Fackenhall, of Brooklyn.

MINNEAPOLIS, MINN.—The Edison Building Company; capital, $130,000. Incorporators, S. G. Cook, J. F. Holdridge, C. H. Maxey and J. M. Totten. The company will carry on a general electric light and power supply business, and erect buildings for the same.

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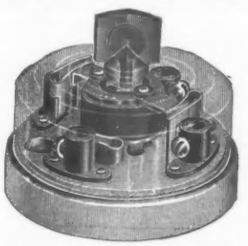
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SUPPLEMENT

Issued February 25th, 1893, by the "ELECTRICAL REVIEW," containing the Full Text of Judge Colt's Decision in the Edison-Beacon Incandescent Lamp Suit.

Edison Again

JUDGE COLT GRANTS ANOTHER INJUNCTION.

The Beacon Company, of Boston, Enjoined, and Goebel's Claims and those of his Witnesses and Experts Discredited.

AN INTERESTING REVIEW OF THE CASE BY JUDGE COLT.

We publish below the complete text of the decision of Judge Colt, handed down in the United States Circuit Court, at Boston, February 18th, 1893. The Edison Electric Light Company, as our readers know, had brought suit to enjoin the Beacon Vacuum Pump and Electric Company, of Boston, from manufacturing incandescent lamps, claiming infringement of the Edison patent. The defendant company set up the new claim that one Heinrich Goebel, of New York, had made incandescent lamps over 25 years before Edison had secured his patent, and that, therefore, the patent was worthless. Many affidavits were presented, the electrical fraternity became greatly interested, and the Judge decided to think it over. The result of his deliberations, which was favorable to Edison, appears in the carefully prepared opinion which is published below:

No. 3096.

CIRCUIT COURT OF THE UNITED STATES.

DISTRICT OF MASSACHUSETTS.

EDISON ELECTRIC LIGHT COMPANY
v.
BEACON VACUUM PUMP AND ELECTRICAL COMPANY, ET AL. } In Equity.

OPINION OF THE COURT.

[FEBRUARY 18, 1893.]

COLT, J. In May, 1885, the plaintiff brought suit in the United States Circuit Court for the Southern District of New York against the United States Electric Lighting Company for infringement of the patent now in controversy, which was granted to Thomas A. Edison, January 27, 1880, for an improvement in electric lamps; and on July 25, 1891, a decree was entered adjudging the validity of the patent and ordering an injunction and account. Upon appeal to the Circuit Court of Appeals for the Second Circuit, the decree was affirmed in October, 1892. Another suit was then brought in the same court against the Sawyer-Man Electric Company, and a preliminary injunction was granted *pro forma* until a decision could be had by the Circuit Court of Appeals, which, on December 19, 1892, affirmed the order, and directed an injunction. Suits were then immediately brought against the Westinghouse Electric Company in Pennsylvania, The Perkins Electric Lamp Company and The Mather Electric Company in Connecticut, and preliminary injunctions obtained.

The present bill was filed January 10, 1893, and the plaintiff now moves for a preliminary injunction against the defendants, based upon the foregoing prior adjudications. This motion is resisted on the ground of newly discovered evidence bearing on the question of novelty of the Edison invention, which was not before the courts in the other cases. As to these other cases, it is said that there has been but one final adjudication upon the merits, which was in the suit against the United States Electric Lighting Company, that the defendants in the other prior suits were so connected with that company that they were in privity with it, and that, therefore, injunctions were granted as a matter of course.

The suit against the United States Company was thoroughly and obstinately contested, as is shown by the record, which covers about six thousand printed pages. The general rule is that where the validity of a patent has been sustained by prior adjudication, and especially after a long, arduous and expensive litigation, the only question open on motion for a preliminary injunction in a subsequent suit against another defendant is the question of infringement, the consideration of other defenses being postponed until final hearing. *Brush Electric Company* v. *Accumulator Company*, 50 Fed. Rep., 833; *Robertson* v. *Hill*, 6 Fisher, 465; *Cary* v. *Domestic Company*, 27 Fed. Rep., 299; *Coburn* v. *Clark*, 15 Fed. Rep., 894; *Mallory Manufacturing Co.* v. *Hickok*, 29 Fed. Rep., 116; *Green* v. *French*, 4 Ban. & Ard., 169; *Blanchard* v. *Reeves*, 1 Fisher, 103; *Goodyear* v. *Rust*, 6 Blatch., 229; *Cary* v. *Lovell Manufacturing Company*, 24 Fed. Rep., 141; *Sargent Manufacturing Company* v. *Woodruff*, 5 Bis., 444; *Kirby Bung Manufacturing Company* v. *White*, 1 McCrary, 155; *Putnam* v. *Keystone Bottle Stopper Company*, 38 Fed. Rep., 234; *Consolidated Bunging Apparatus Company* v. *Peter Schoenhofen Brewing Company*, 28 Fed. Rep., 428; *Newall* v. *Wilson*, 2 DeGex, M. & G., 282; *Davenport* v. *Jepson*, 4 DeGex, F. & J., 440; *Bouille* v. *Goodier*, 35 Beav., 437.

The only exception to this general rule seems to be where the new evidence is of such a conclusive character that, if it had been introduced in the former case, it probably would have led to a different conclusion. The burden is on the defendant to establish this, and every reasonable doubt must be resolved against him. *Ladd* v. *Cameron*, 25 Fed. Rep., 37; *Cantrell* v. *Wallick*, 117 U. S., 689; *Winans* v. *Eaton*, 1 Fisher, 181; *Bailey Wringing Machine Company* v. *Adams*, 3 Ban. & Ard., 96; *Norton Door Check and Spring Company* v. *Hall*, 37 Fed. Rep., 691; *Lockwood* v. *Faber*, 27 Fed. Rep., 63; *Glaenzer* v. *Wiederer*, 33 Fed. Rep., 583; *Cary* v. *Domestic Spring Bed Company*, 36 Fed. Rep., 38.

There is no denial of infringement in the present case under the construction given to the patent in prior adjudications. The contention of the defendants is, that this motion should be denied on the ground that they have recently discovered that Henry Goebel, a German watchmaker, living in New York, invented the Edison incandescent lamp as early as 1854, and that, therefore, the Edison patent is void for want of novelty, or, at least, must be limited to the coiled form of filament. This is the same line of attack upon the patent which was unsuccessfully made in the case against the United States Electric Company. It was there urged that the Starr lamp of 1845, the Roberts lamp of 1852, the Lodyguine, Konn, and other lamps which appeared between 1872 and 1876, the Boulguine lamp of 1877, the Sawyer and Man lamp of 1878, and the Edison platinum lamp of 1879, limited the Edison patent to narrow inventions or rendered it void for want of patentable novelty. But the court, with a most exhaustive review of the prior art before it, refused to take this view and held that the second claim of the patent, read with the specification, covered a broad and fundamental invention, namely, an incandescent lamp composed of a carbon filament hermetically sealed in an all glass chamber exhausted to a practically perfect vacuum, and having leading-in wires of platinum. Judge Wallace, in his opinion in the Circuit Court, says: "Read by those having this knowledge, the radically new discovery disclosed by the specification is that a carbon as attenuated before carbonization as a linen or cotton thread, or a wire seven one thousandths of an inch in diameter, and still more attenuated after carbonization, can be made which will have extremely high resistance and be absolutely stable when maintained in a practically perfect vacuum. It informs them of everything necessary to utilize this discovery and to incorporate it into a practical lamp. It describes, with the assistance of the recital in the second claim, as the vacuum in which the burner is to be maintained, a bulb made wholly of glass, exhausted of air, sealed at all points by the fusion of the glass, and in which platinum leading wires are sealed by the fusion of the glass. It describes the materials of which the burner is to be made and instructs them that the materials are to be shaped into their ultimate form before carbonization. It describes the use of platinum for the leading wires, and a method of securing the leading wires and filaments, intended to dispense with clamping, which consists in moulding tar putty about the joints, and carbonizing the whole in a closed chamber."

By this invention Edison disclosed to the world for the first time a practical, commercial incandescent lamp, adapted for domestic uses. The problem was by no means easy of solution.

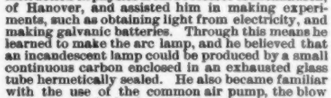
To subdivide the electric light and embody it in a cheap and durable domestic lamp, capable of successfully competing with gas, had for years baffled the science and skill of the most eminent electricians in this country and in Europe. The difficulty lay in the practical construction of a durable incandescent lamp rather than in a knowledge of the elements which should compose such a structure. Carbon burners, platinum wires, exhausted glass receivers were old and well known. As early as 1845, Starr suggested in the King patent a lamp composed of a thin pencil of carbon enclosed in a Torricellian vacuum, and Roberts, in 1852, proposed to cement the neck of the glass globe into a metallic cup and to provide it with a tube for exhaustion by means of a hand pump. Later, Lodyguine and others provided their lamps with several short carbon pencils which were successively brought into circuit as the pencils were consumed, also various devices for perfecting the joints between the metal base and the glass globe, while Sawyer and Man, in 1878, made the bottom plate of glass instead of metal, and charged the lamp with an atmosphere of nitrogen gas to avoid destruction of the burner from oxidation. In his 1879 lamp, Edison used a platinum burner which proved a failure because the platinum melted near the point of incandescence. Mr. Schwendler, a noted English electrician, said in 1879: "Unless we shall be fortunate enough to discover a conductor of electricity with a much higher melting point than platinum, and which at the same time does not combine at high temperature with oxygen, we can scarcely expect that the principle of incandescence will be made use of for practical illumination."

The arc lamp was known as early as 1844, but its great light made it unfit for use in dwellings. The question was how to divide the electric light for domestic purposes. Many scientists considered the problem as hardly within the range of possibility. From the results of the experiments of Fontaine, the French scientist, published in 1877, it would seem that almost insurmountable obstacles, founded on the operation of natural laws, stood in the way of the successful division of the electric light. Mr. Preece, the electrician for the British General Post Office, pronounced, early in 1879, that "the division of the electric light is an absolute *ignis fatuus*."

Those who dissented from this view were Mr. Edison in this country and Mr. Lane-Fox in England, who both reached the conclusion that the subdivision of the electric light could be accomplished, provided the radiating surface of the burner of the lamp was reduced in extent so that only a moderate volume of light would be emitted, while at the same time the resistance of the burner was increased so as to enable the employment of relatively small conductors for leading the electric current to the lamps; or, shortly stated, the burner should have a high ratio of resistance to radiating surface. Edison first embodied this discovery in his platinum lamp in 1879, but this lamp was unsatisfactory, and the problem remained unsolved. While experimenting with the platinum lamp, Edison discovered that the passage of a current through the platinum during the process of exhausting the enclosing chamber would drive out occluded gases, and thereby raise the melting point of the burner. This led him to secure greater perfection in the vacuum by the employment of a highly exhausted glass chamber similar to those used by Crookes, made entirely of glass, and with all the joints closed by the fusion of the glass. After the failure of the platinum lamp, it occurred to Edison to substitute a short filament of carbon in place of the long platinum burner into the nearly perfect vacuum chamber, and it was found that such filament was stable at high temperature and free from disintegration and oxidation. It was thus made known that the disintegration of the carbon burner was not caused by the electric current, but was due to "air washing," or the attrition produced by the passage of the air over the highly heated surface of the carbon.

As late as 1878 Mr. Sawyer, in a patent to Sawyer and Mann, stated that no incandescent lamp had yet been devised which was practically operative, because of the defective methods employed for charging the lamp with artificial atmosphere, which resulted in the disintegration of the carbon; second, because it was impossible under varying degrees of heat and pressure to maintain perfect joints; third, because unequal expansion of the carbon and its holder had resulted in fractures of the burner. But Edison overcame these obstacles and produced a practical lamp. When we review the literature which preceded this invention, the subtle force with which it had to deal, whose laws had to be intelligently investigated and understood, the well-nigh perfect workmanship necessary in construction, and the slow steps by which the end was finally reached, it seems on its face almost incredible that the incandescent lamp of Edison was in fact invented and operated by Henry Goebel in New York 40 years ago, and publicly exhibited before hundreds of people.

Goebel's story runs thus: He came to this country from Germany in 1848. He was a watchmaker and optician by trade, and opened a shop on Monroe street in New York. While in Germany he received instruction in physics from Professor Munchhausen, of Hanover, and assisted him in making experiments, such as obtaining light from electricity, and making galvanic batteries. Through this means he learned to make the arc lamp, and he believed that an incandescent lamp could be produced by a small continuous carbon enclosed in an exhausted glass tube hermetically sealed. He also became familiar with the use of the common air pump, the blow pipe, the method of producing the Torricellian vacuum, and the making of carbon conductors.

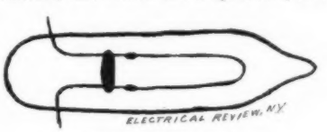


GOEBEL FIDDLE-BOW LAMP.

He says he learned at this time that the co-efficient of the expansion of glass and platinum were the same. As soon as he obtained money enough from his regular business, he began experimenting with electricity in his shop in New York. Soon after his arrival he exhibited an arc lamp on the top of his house, which called out the fire engines and caused his arrest. He then turned his attention to incandescent lamps, and made a number of them. The first form of lamp he constructed was called a "fiddle-bow" or "meat-saw," and it consisted of an exhausted tube made of glass, in one piece, with leading-in wires sealed into the enclosing chamber by fusion of the glass. The wires with the carbon burner attached resembled in form a fiddle-bow.

The next style of lamp was called the "hairpin," from the shape of the carbon burner.

A third form of lamp was also made about this time, presenting the carbon and connecting wires in a straight line, but this proved unsatisfactory, as the burner broke with the heat. The leading wires were sometimes made of platinum, but generally of iron or copper, which was less expensive. The carbons used were less than one-hundredth of an inch in diameter, and were made from flax, reed, and black cane. The first lamps were exhausted by the common air-pump, but not getting a good vacuum they were subsequently exhausted by filling the tubes with mercury, inverting them, and allowing the mercury to run out, and then sealing them off. Before sealing, the incandescent conductor was heated slightly, which, together with a little shaking, made the mercury that stuck to the carbon fall off. The ends of the leading wires were flattened, then twisted into a spiral tube, into



GOEBEL HAIR-PIN LAMP.

which the ends of the carbons were inserted, and the tubes were then compressed. The joints were generally cemented with heated stove polish, though sometimes the ends of the carbon were electro-plated with copper, and an amalgam of gold and mercury applied to the joints which adhered to the copper, and sometimes a platinum sponge was used for this purpose. The electric current was produced by chemical action from batteries. The first lamps were made from cologne bottles, but afterwards from glass tubes.

A large number of the fiddle-bow and hair-pin lamps were made while living on Monroe street, between 1850 and 1872, and there was no six months up to the year 1880 when a number was not made, and prior to 1879 more than a hundred were constructed. No secret was made of any part of their construction, and they were lighted and shown to whomever desired to see them, and there was no time until after 1880 when several of the lamps were not in his possession.

If the carbons did not burn up as soon as the current was turned on, the life of the lamp was almost indefinite, but it could not be run very long at a time because the battery would give out. These lamps were used upon a wagon carrying a telescope, which was taken to Union Square and Cooper Institute for exhibition. For looking through the telescope a small fee was charged, and the lamps were used partly for light and partly to attract attention. Many hundreds of people saw these lamps while so exhibited. Another lamp was arranged to illuminate the face of a clock which hung in his bed room, and this use was continued in his Grand street house.

After removing to 468 Grand street, which was in 1877, he made a mercury vacuum pump, the idea having been suggested by hearing of the Geissler pump. In using the old process to exhaust the lamps, particles of mercury adhered to the interior parts, and it was with considerable difficulty that these particles were got out. A patent was obtained on this pump January 24, 1882. In 1881, he was employed by the American Electric Light Company. He refused to leave his shop, but his son Adolph, now dead, worked for the company at its factory. About this time Mr. Crosby, who was connected with the company, called upon him several times and was much interested with his lamps, and engaged him to make carbons and exhaust lamps. Until he worked for the company he never heard of Edison or his incandescent lamp, or of a dynamo machine for electric lighting, and had never read anything on the subject in the public prints. He does not read English, but speaks and understands it fairly well.

The Goebel lamp, Exhibits 1, 2 and 3, he recognizes as his own manufacture, and says that these very lamps were made before gas was put into his house on Monroe street. These lamps are of the fiddle-bow form. He is positive they were made before gas was introduced into his house, because they are discolored by smoke from an oil lamp flame employed in the use of the blow-pipe.

After arguments on the motion, Goebel filed a supplemental affidavit and produced another lamp, known as Exhibit 4. This lamp has leading-in wires of platinum, and is of much superior workmanship and finish. He also produced several tools for making carbons, and describes their use. He declares that before 1872 he had arrived at a definite conclusion as to the best material for making carbons and had settled upon bamboo. He had also decided upon platinum as the best leading-in wire, and stove polish as the best material for cementing the joints. He says that lamp No. 4 has been in his possession since before moving from Monroe street in 1872, that he made it and burned it a good many times before and since, that he made other lamps both in Monroe and Grand streets with carbonized bamboo burner, platinum leading wire connections, and glass tube, similar to No. 4, but he doubts if in any other lamps the glass feature was as handsome as in this exhibit. He has recently been informed that Mr. Pope had given as a reason why he did not think this lamp was made by the Torricellian vacuum, that there would in such case be a deposit of mercury upon the surface of the copper wire which connects the carbon with the platinum wire, and that he discovered no such appearance. He told Mr. Pope he was mistaken, provided that distilled mercury was used in producing the vacuum. The mercury that he used in producing the vacuum in these lamps was carefully distilled, sometimes three or four times, before it was used, and the process was always performed in a dry atmosphere, and other safeguards used, such as heating the mercury slightly. He had also em-

ployed, previous to 1872, a mercury pump in which no mercury was present in the glass part of the lamp, but he succeeded better with the Torricellian process than with this early mercury pump. As compared with the incandescent lamps of to-day, these early lamps gave a fairly good light. He declares he has received no money for his affidavits, and has no interest in this suit, and that he has given his evidence reluctantly, and after considerable urging.

I have given the substance of the leading points of Goebel's affidavits because this case rests largely upon them. With respect to the age and history of lamp No. 4, it may be said that the evidence rests entirely upon his affidavits and that of his son, Henry Goebel, Jr.

The defendants produce some forty affidavits in confirmation of the statement of Goebel respecting his lamp. Of these witnesses, five are his children, one his niece, and the remainder nearly all friends or acquaintances. So far as appears, these people are respectable and truthful. They testify generally to seeing the Goebel electric lamp in his shop and on his wagon containing the telescope at various times between 1850 and 1882, the time and the circumstances in many instances being given in detail, and some twenty witnesses identify the early fiddle-bow lamps as the same as those which they saw. Several witnesses also observed the lamp connected with the clock. To some Goebel explained how the lamps were made, and several assisted him in their construction. Some declare the light was good, but do not state the length of time the lamp would burn. Generally speaking, the testimony is confined to the old fiddle-bow lamp, and relates to a period prior to or about 1860. A number of witnesses testify as to the good character, honesty, and truthfulness of Henry Goebel.

It appears from the affidavit of Mr. Bull, an attorney at law, that Henry Goebel, Jr., delivered lamp No. 1 to him at his office in New York, October 18, and lamp No. 2, November 28, 1892, and that when received both the carbons were detached from the leading-in wires, and that he was then informed by Goebel that both the carbons were intact when he put the lamps in his pocket to bring them to his office. Henry Goebel, Jr., states that he delivered lamp No. 3 to Mr. Bull at the same time with No. 2, and that he broke the carbons in lamps 1 and 2 on the way to Mr. Bull's office.

From Mr. Williams's affidavit, it seems that gas was introduced in Monroe street in or about the year 1854, this, with the testimony of the elder Goebel and other witnesses, fixes the date of the construction of lamps 1, 2 and 3 as early as 1854.

Mr. Curtis, the council for the defendants in the New York cases, states that he first heard of Henry Goebel in the early part of 1882, and that in answer to his questions, he said that he had made incandescent lamps like Edison's as early as about 1850. Owing to Goebel's imperfect English he had difficulty in understanding him. He gathered from the conversation that Goebel had not made any use of the lamps except for laboratory experiments, and that his work was not continued for more than a year or two after 1850. He asked him to produce some lamps, and he said he would look them up. His recollection is that he saw Goebel again, but that he had no further information to impart.

In the latter part of 1890, Mr. Bull, who had been council for the Consolidated Electric Company, informed him that Goebel's sons corroborated their father's statement and that further additional evidence could be procured, but after consultation with Gen. Duncan they concluded that the evidence was not sufficient to warrant an application to reopen their case to admit it. At the time of the injunction motion in the Sawyer-Man case, in November, 1892, he made further inquiry in regard to Goebel, and was informed that some additional evidence had been obtained. Upon consultation with his associates, Mr. Wetmore and Mr. Root, it was concluded that the matter had not been sufficiently developed to present it as a defence in that case. Mr. Curtis goes on to state that, had he known of anything like the character and extent of the Goebel evidence as presented in this case, he should have regarded it of the greatest importance, as constituting one of the best defences in their cases.

In further support of the Goebel anticipation, several experts give affidavits to the effect that the Goebel lamp, assuming that it was made prior to 1879, contains the broad invention covered by the second claim of the Edison patent, as it embodies the same combination of a carbon filament with an all glass exhausted receiver and conductors passing through the glass.

Mr. Pope declares that Goebel lamps 1, 2 and 3 have a carbon filament within the meaning of the second claim of the Edison patent as defined by the court, a receiver made entirely of glass and exhausted of air, and conductors passing through the glass, and all these elements combined for the purpose set forth in the patent; that these structures embodied the conception that carbon would stand high temperature, even when very attenuated, if operated in a high vacuum, without the phenomenon of disintegration.

He finds these particular lamps are not now in a condition to be operated, but he is satisfied that when first constructed they were capable of such operation, and had in fact been so operated. He knows of no reason why these lamps should not have been made long prior to 1879, and should not last as long and be as practically useful as many forms of lamp described by Edison in his patent. He finds the leading-in wires in lamps 1 and 2 to be of iron, and in 3 of copper. In No. 3 he finds the leading-in wires are sealed by fusion into the lower end of the glass chamber, the glass being pressed around them when hot. The filament is made of carbonized woody fiber, apparently of bamboo or cane, and has a diameter approximately of eight to ten one-thousandths of an inch. The glass chamber is five inches long and seven-eighths of an inch in diameter, but is now cracked near the bottom, and, consequently, there is no vacuum.

Mr. Cross confirms these statements, and calls particular attention to the fact that the Goebel carbon is by reason of its small diameter a "filament," as distinguished from a "coil," according to Professor Ayrton's tables, and in the sense in which that term is used in the Edison patent as judicially construed.

In a second and supplementary affidavit, Mr. Pope says, with respect to the highly finished Goebel lamp No. 4, which has platinum leading-in wires and hair-pin shaped carbon, that at first he had doubts whether it was constructed as early as Goebel, and his son Henry, said, or prior to 1872. This arose from the circumstance that the joint between the carbon and copper wire appears to have been made in part by electro-plating, and his experience led to the opinion that if the lamp had been first filled with mercury and then exhausted by inverting the tube, in one of the ways Goebel practiced, the mercury would have united with the surface of deposited copper, and some traces of it remained, but as no such traces appeared visible in this lamp, he was led to believe that it must have been exhausted upon a vacuum pump. Upon questioning Goebel, however, he found that he had used chemically pure or distilled mercury. Afterwards, Mr. Pope, by experiments, discovered that chemically pure mercury did not adhere to copper, nor leave any discoverable trace. This is the reason why this lamp was not before the court at the arguments on this motion.

Mr. Pope is unable to get a current through this lamp because the circuit is somewhere broken. He sees no reason why it might not have been made before 1872. He is of opinion that it represents an advance over the prior Goebel lamps in details of construction and general workmanship, and that it is entirely capable, with the break repaired, of practical use as an incandescent lamp. He thinks it would burn without doubt three or four hundred hours, and that it clearly embodies the invention of the second claim of the Edison patent, as construed by the court. He is also of opinion that iron leading-in wires are practicable in the continuous or an incandescent lamp, and that it is best thing to platinum. Mr. Cross, in a supplemental affidavit, confirms these statements. Mr. Cary, the electrician of the defendant company, states in an affidavit, that from experiments he has recently tried incandescent lamps capable of practical use can be made with iron leading-in wires.

There was filed at the same time with the foregoing supplemental affidavits, other affidavits of persons who knew Goebel and saw his lamps. The light from the Goebel lamp seems to grow brighter and more steady as the affidavits multiply. For example, Mr. Voss, in his second affidavit, says: "Some of the larger lamps were attached in the store like gas fixtures. . . . I have seen the store lighted with these electric lamps alone when the gas was turned off, and the light in the store was a nice brilliant light of, I should say, from eight to ten candle-power to the lamp." Again, Mr. Hall states that the store was entirely lighted up by these lamps, which were brighter than gas jets; in fact, too bright, and that the light was very steady. Mrs. Stark says the lamps were brighter than an oil lamp or gas flame, and would burn an hour. George Pasbach, who married Goebel's niece, declares he could see to read by their light, and do fine work. Edward F. Mulligan says the lamps in the Monroe street store gave a nice bright light, whiter and much better than gas, and that you could easily read or do work by it.

To meet this alleged Goebel anticipation, the plaintiff introduces the prior adjudications upon the Edison patent, the affidavits of Edison and Barker relating to the history of the invention and the prior state of the art, and the affidavit of Upton shows that the defendant company was incorporated in 1890, and is now an active competitor in manufacturing and selling incandescent lamps. The plaintiff also produces the affidavit of Prof. Elihu Thomson to the effect that the Goebel lamps, like Exhibits 1, 2 and 3, could not have been useful for ordinary lighting purposes, and were never a practically operative light. One reason for this is, because the leading-in wires are of iron or copper, under which conditions a vacuum cannot be maintained, since the rate of expansion of iron and copper is very different from glass, the result being that the lamp begins to lose its vacuum as soon as it is heated and cooled. Another reason is that the leading-in wires are poorly and crudely sealed in, the glass work being thoroughly bad, and the lamps cracked and blackened on the ends by improper flame. While these lamps, in spite of leakage, might have been used for a short time, they could not have had a sufficient brilliancy for ordinary lighting purposes, nor possessed any commercial value. The vacuum not being maintained, the heat would be carried away from the incandescent body by currents of gas, and this waste of energy robs the burner of its light-giving power. This statement by Professor Thomson is agreed to and confirmed by the affidavits of John W. Howell and John E. Randall.

Prof. Thomson further says, that he remembers Henry Goebel as far back as 1881 or 1882, and that he visited his shop at that time, and that an endeavor was made to impress him with the value of the Goebel anticipation.

The plaintiff, also, by permission of court, filed affidavits after the arguments on the motion. These are important, not only as contradicting statements found in the affidavits of defendants, but for other reasons.

A number of these witnesses, who were neighbors or acquaintances of Goebel, or had other means of knowledge, deny that he exhibited any electric lights in connection with his telescope or in his shop about 1860 or the years following.

There are the affidavits of John W. Howell and Frank Holzer, electricians, who corroborate the statement of Professor Thomson, that the Goebel lamps 1, 2 and 3 were never practically operative by reason of a defective vacuum, and never possessed any commercial value.

Several witnesses state that Goebel spoke English well, and it is also proved that articles relating to the subject of incandescent lamps and Edison's inventions were printed during 1880 in the *Staats Zeitung*, a German daily newspaper, published in New York.

But the more important evidence has reference to those persons who saw or dealt with Goebel, and who investigated his claim to have anticipated Edison in the art of incandescent lighting.

William C. Dreyer states that he undertook to form a company to purchase from Henry Goebel his inventions and patents, and that in 1882 he did procure from him an option for three months of all his inventions relating to electric lighting upon payment to him of $500, and an extension of the option for another three months, for which an additional $425 was paid. Goebel was also to have a large compensation from the company if formed. At that time, he said, he had patented or applied for patents on a mercury pump and a spiral holder for the carbon in an incandescent lamp. He said he had made small incandescent lamps, called the fiddle bow. It was considered of great importance to have one of these lamps, and he made every effort to find one, but never succeeded. The conversations with Goebel were carried on in German. The production of an old lamp was vital in this matter. During this time negotiations with the Edison Company were attempted through S. B. Eaton. The whole subject was gone over with E. N. Dickerson, the patent lawyer, who said that even if Goebel did what he claims, it was nothing but an abandoned experiment. The negotiations with the Edison Company were in consequence dropped.

Albert Hetschel, a manufacturer of thermometers and scientific apparatus, states that in 1881 he was in the employ of the American Electric Light Company, and was directed to work with and help Henry Goebel, and was at his shop for several months. Hetschel describes how Goebel in a crude way made three or four little incandescent lamps with the use of a poor vacuum pump; that he was unable to make a successful lamp, and he is certain that if he had possessed at that time any incandescent lamps he would have shown them.

Otto A. Moses, a mining engineer, then in the service of the Edison Company, visited Goebel in 1884. Goebel made some carbons for him. During this time, being much interested in the subject, he inquired of Goebel what he had done in the field of incandescent lamps. He examined all the lamps Goebel had and asked him to produce some of his old ones. Goebel requested permission to visit his laboratory and did so, and afterwards solicited employment for himself and his son. Under these circumstances, he says it is improbable that Goebel at that time had any old meat-saw or hair-pin lamps in his possession.

Ludwig K. Bohm, an electrical expert, who was associated with Edison in 1879, and afterwards in 1881 electrician of the American Electric Light Company, had several conversations with Goebel at the office of the company. At that time Edison's invention had been published in the English and German papers in New York. He conversed with Goebel in German on the subject of incandescent lighting, and he is certain that no one of those mentioned his historical lamps if he had made them.

He then proceeds to discuss the lamps described in Goebel's affidavit, and declares that a vacuum sufficiently high to enable a filamentary carbon to last could not be made by filling the tube with mercury and then inverting it, because there is always air in the mercury, and that air would have the glass walls. In making standard barometers by the Torricellian vacuum it was found necessary to boil them out for hours in specially constructed apparatus. Further, owing to the specific gravity of mercury, the filamentary carbon would be broken during the operation of filling and inverting the chamber. The lamps are likewise imperfect from the use of iron or copper leading-in wires, and no one of them shows any evidence that it ever contained a good vacuum.

William McMahon in 1880 was interested in starting a company to compete with the Edison lamp, and he and his associates, George Crosby and Edwin Fox, organized the American Electric Light Company in 1881. Crosby took him and his brother to Goebel's shop to talk over electrical matters. Goebel showed him an arc lamp, but said he had never made any incandescent lamps. He remembers also seeing some carbons and a vacuum pump which appeared like a swinging pump. Goebel's son was soon after employed by the American Company. There was intense excitement at this time over the Edison incandescent lamp. Everybody recognized that Edison had made the invention. There was every reason at the time why Goebel and his son should have disclosed fully what they had done in this direction. If any one had preceded Edison in his invention, unlimited capital could have been secured for an opposition company. The American Company wanted to make the Edison lamp, but did not dare to. For these reasons he is satisfied that Goebel never made an incandescent lamp prior to March, 1881. Thomas G. McMahon, his brother, confirms this story in his affidavit.

Sherburne B. Eaton, the legal adviser of the Edison Company, states that in May, 1882, the law firm of Dickerson & Dickerson called his attention to the alleged inventions of Henry Goebel. They said that he claimed to have invented an incandescent lamp resembling the Edison. Goebel's representative in this matter was William C. Dreyer. No price was made, but we were asked to look into the matter. The subject was laid before the Executive Committee of the Edison Company, and it was decided that Goebel had nothing worth buying. Mr. Dickerson's opinion was that if Goebel had made the inventions he claimed, they amounted to nothing more than an abandoned experiment. On November 28, 1882, Henry Goebel, Jr., called upon him, as representing the Edison Company, and made another offer to sell the inventions and good will of his father, naming the price of $20,000, and the matter was again submitted to the company. On December 12, 1882, he called again and was informed that the company did not wish to buy.

A patent was issued to Henry Goebel for an improvement in electric incandescent lamp, October 24, 1882. This invention has reference to securing and cementing the carbon burner into flattened and spirally coiled ends of the conducting wires. The second claim, as drawn in the original application, was rejected by reference to the Edison patent, now in suit.

Upon consideration of the whole of the evidence on this motion, I have reached the following conclusion:

It is extremely improbable that Henry Goebel constructed a practical incandescent lamp in 1854. This is manifest from the history of the art for the past 50 years, the electrical laws which since that time have been discovered as applicable to the incandescent lamp, the imperfect means which then existed for obtaining a vacuum, the high degree of skill necessary in the construction of all its parts, and the crude instruments with which Goebel worked.

Whether Goebel made the fiddle-bow lamps 1, 2 and 3 it is not necessary to determine. The weight of evidence on this motion is in the direction that he made these lamps or lamps similar in general appearance, though it is manifest that few, if any, of the many witnesses who saw the Goebel lamp could form an accurate judgment of the size of the filament or burner. But assuming they were made, they do not anticipate the invention of Edison. At most they were experimental toys used to advertise his telescope, or to flash a light upon his clock, or to attract customers to his shop. They were crudely constructed, and their life was brief. They could not be used for domestic purposes. They were in no proper sense the practical commercial lamp of Edison. The literature of the art is full of better lamps, all of which were held not to anticipate the Edison patent. The fact demonstrated that to protect a carbon filament $\frac{1}{100}$ of an inch in diameter from speedy disintegration the lamp chamber must maintain a nearly perfect and stable vacuum, and every part of the structure must be composed of such materials and so put together as not to imperil this vital condition. Leaving out of the question the fact already shown that the Goebel lamp did not possess this requirement, and could not by reason of the elements which entered into its composition and the mode in which it was constructed. Goebel says he made more than 100 lamps, and that a continual improvement took place in their construction, and yet the only three lamps produced at the hearing, by his own confession, were made as early as 1854, or before gas was introduced into his house. Where are the other lamps which show these improvements, except Exhibit 4, which I will deal with presently? The evidence of Goebel and his witnesses point to the conclusion that work ceased on these lamps in the "fifties," and was not revived until Edison, 30 years later, startled the electric world with his invention. Goebel brought from Germany the ideas contained in the old lamp of Starr, with its carbon pencil enclosed in a Torricellian vacuum, and he probably constructed some lamps after that pattern. In doing this he was up to and in line with the art as it existed at that early day, but to say that with a sudden bound he jumped from Starr to Edison passes the limits of credulity. The history of great inventions shows a gradual and labored progress. Each new investigator records some advance, until it may be the desired discovery is almost within his grasp, but it is only after many attempts and many failures that some one appears who accomplishes the long sought for result. The discovery of the domestic incandescent lamp is no exception to this rule, as the record in the New York case bears witness. Speaking from the standpoint of the art of incandescent lighting in 1854 and in 1892 are two different things, and it is, therefore, quite easy for witnesses to think that Goebel did much more than there is any legitimate reason to suppose.

As for lamp No. 4, I cannot but view it with suspicion. It presents a new appearance. The reason given for not introducing it before the hearing is unsatisfactory. This lamp, to my mind, envelopes with a cloud of distrust the whole Goebel story. It is simply impossible under the circumstances to believe that a lamp so constructed could have been made by Goebel before 1872. Nothing in the evidence warrants such a supposition, and other things show it to be untrue. This lamp has a carbon filament, platinum leading-in wires, a good vacuum, and is well sealed and highly finished. It is said that this lamp shows no traces of mercury in the bulb because the mercury was distilled, but Goebel says nothing about distilled mercury in his first affidavit, and twice he speaks of the particles of mercury clinging to the inside of the chamber, and that for this reason he constructed a Geissler pump after he moved to 24 Grand street, which was in 1877. Again, if this lamp has been in his possession since before 1872, as he and his son swear, why was it not shown to Mr. Crosby, of the American Company, when he visited his shop in 1881, and was much interested in his lamps? Why was it not shown to Mr. Curtis, the leading counsel for the defendants in the New York cases, when he was asked to produce a lamp and promised to do so? Why did not his son take this lamp to Mr. Bull's office in 1892, when he took the old fiddle-bow lamps 1, 2 and 3? Why did not his son take this lamp to Mr. Eaton's office in 1882, when he tried to negotiate the sale of his father's inventions to the Edison Company? A lamp so constructed and made before 1872 was worth a large sum of money to those interested in defeating the Edison patent, like the American Company, and Goebel was not a rich man. Both he and one of his sons were employed in 1881 by the American Company. Why did he not show this lamp to McMahon when he called in the interests of the American Company and talked over electrical matters? When Mr. Dreyer tried to organize a company in 1882, and procured an option from him of all his inventions relating to electric lighting, for which $925 was paid, and when an old lamp of this kind was of vital consequence and would have insured a fortune, why was it not forthcoming? Mr. Dreyer asked Goebel to produce an old lamp and was especially anxious to find one pending his negotiations with the Edison Company for the sale of Goebel's inventions. Why did he not produce this lamp in his interviews with Bohm of the American Company, or Moses of the Edison Company, when it was for his interest so to do? The value of such an anticipation of the Edison lamp was made known to him. He was desirous of realizing upon his inventions. He was proud of his incandescent lamps, and was pleased to talk about them with anybody who would listen. Is it conceivable, under all these circumstances, that he should have had this all-important lamp in his possession from 1872 to 1893, and yet no one have heard of it or seen it except his son? It cannot be said that ignorance of the English language offers an excuse. He knew English very well, although Bohm conversed with him in German. His children spoke English. Neither his ignorance nor his simplicity prevented him from taking out three patents, the first in 1865 for a hemmer, and the last in 1882 for an improvement in incandescent lamps. If he made lamp No. 4 previous to 1872, why was it not also patented?

There are other circumstances which throw doubt on this alleged Goebel anticipation. The suit against the United States Electric Lighting Company was brought in the Southern District of New York, in 1885. Large interests were at stake, and the main defence to the Edison patent was based upon prior inventions. This Goebel claim was then investigated by the leading counsel for the defense, Mr. Curtis. It was further inquired into in 1892, in the case against the Sawyer-Man Company. It was brought to the attention and considered by the Edison Company in 1882. It was at that time known to the American Company, who hoped by this means to defeat the monopoly under the Edison patent. Dreyer tried to organize a company for its purchase. Young Goebel tried to sell it. It must have been known to hundreds of people. And now, when the Edison Company, after years of litigation, leaving but a short time for the patent to run, have obtained a final adjudication establishing its validity, this claim is again resurrected to defeat the operation of the judgment so obtained. A Court of Equity should not look with favor on such a defence. Upon the evidence here presented, I agree with the first impressions of Mr. Curtis, and with the opinion of Mr. Dickerson, that whatever Goebel did must be considered as an abandoned experiment.

It has often been laid down that a meritorious invention is not to be defeated by something which rests in speculation or experiment, or which is rudimentary or incomplete. The law requires not conjecture, but certainty. It is easy, after an important invention has gone into public use, for persons to come forward with claims that they invented the same thing years before, and to endeavor to establish this by the recollection of witnesses as to events long past. Such evidence is to be received with great caution, and the presumption of novelty arising from the grant of the patent is not to be overcome, except upon the most clear and convincing proof. *Coffin* v. *Ogden*, 18 Wall., 120; *Brush* v. *Condit*, 132 U. S., 39; *The Telephone Cases*, 126 U. S.; *American Bell Telephone Company* v. *People's Telephone Company*, 22 Fed. Rep., 309; *Motte* v. *Bennett*, 2 Fisher, 642; *Parham* v. *American Buttonhole Company*, 4 Fisher, 468; *La Baw* v. *Hawkins*, 1 Ban. & Ard., 428; *Gottfried* v. *Philip Best Brewing Company*, 5 Ban. & Ard., 4; *Worswick Manufacturing Company* v. *City of Buffalo*, 32 Fed. Rep., 128.

When the defendant company entered upon the manufacture of incandescent lamps in May, 1891, it well knew the consequences which must follow a favorable decision for the Edison Company in the New York case.

Owing to the large interests involved, I have carefully considered this motion, and I am satisfied upon the evidence, and the law applicable thereto, that it should be granted.

Injunction granted.